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Dr. Allan Bromley
Science Advisor to the President
Executive Office
17th Street and Penn. Avenue, N.W.
Washington DC, 20506

Dear Dr. Bromley :

Enclosed you will find several papers we thought you might be interested in seeing. They were presented at the Applied Superconductivity Conference August 24 - 28. Please excuse the quality of the graphics as these are pre-press copies. Reprints will be available in a few weeks. Please contact Lisa Nelles or myself at (617) 923-1122 if you would like reprints when they are available.

Sincerely,


Dr. Gregory Yurek
President and CEO

MULTIFILAMENTARY Bi-2223 COMPOSITE TAPES MADE BY A METALLIC PRECURSOR ROUTE

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Abstract-- A process based on metallic precursors has been developed for manufacturing high filament count oxide superconductor - silver composite tapes with critical current densities of up to 7.5 kA/cm^2 at 77 K in zero field. A 30-cm prototype multi-strand conductor made of these tapes has a critical current of 240 A at 77 K over a 9 cm gauge length, with an average critical current density of 6 kA/cm^2 . The mechanical properties of tapes made from metallic precursors containing up to 10,000 Bi-2223 superconducting oxide filaments were investigated. Critical tensile strains average 0.6%, and bend tests show negligible dropoff in current density up to a 0.70% surface strain. The critical current decrease beyond the 0.70% surface bend strain follows a simple model based on extensive filament damage beyond the critical tensile strain. Increased flow stresses of the composite tapes, compared to similarly processed silver, indicate considerable strengthening of the composite by the oxide filaments.

I. INTRODUCTION

High temperature superconducting (HTS) wires and tapes are of great interest for high current applications such as power transmission cables, motors, magnets and energy storage devices (SMES). These applications will require wires or tapes with (1) high critical current densities (and currents), (2) long lengths, and (3) robust mechanical properties.

Most of the progress toward suitable HTS wires and tapes is focused on the Bi-2223 composition and the oxide-powder-in-tube (OPIT) process. In recent demonstrations of the capabilities of this technology, American Superconductor Corporation (ASC) fabricated a 19-filament composite tape with a core current density J_c ($1\mu\text{V/cm}$ offset criterion [1], 77 K, self-field) of 9.0 kA/cm^2 over 62 meters [2], and Sumitomo Electric Industries fabricated a 61-filament tape with a J_c of 9.7 kA/cm^2 over 114 meters [3]. The record performance over short lengths has reached an impressive 54 kA/cm^2 at 77 K, with much higher values reported at 20 K, even in the presence of large magnetic fields [4].

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With the demonstration of such performance levels, fabrication of first-generation, HTS prototype magnets, coils and multi-strand conductors has begun. Indeed, magnet coils exceeding 1T at 4.2K have already been built [4,5] by a "wind and react" technique. In such a process, the final reaction in the tape is performed at temperatures exceeding 800°C after the prototype is wound because limitations on the mechanical properties prevent significant handling of the tape after the final reaction. This approach has significant disadvantages, however, including the need for bulky, high-temperature resistant insulation as well as both reaction and insulation process optimization for each prototype configuration. Wind-and-react tapes are also likely to be more sensitive to subsequent mechanical and thermal cycling.

Therefore, a great deal of effort is focused on improving the mechanical properties of HTS wires and tapes (in addition to J_c) so that they allow a "react and wind" process for most applications. Data from ASC [2] and Sumitomo [6] on OPIT tapes indicates a clear improvement in bending strain tolerance with increasing filament count. A key therefore to the manufacture of the flexible and durable wires needed for a react-and-wind sequence is an economically viable process for making composites with large numbers of fine filaments. One promising alternative to OPIT for making such structures with superior mechanical properties and manufacturability is the metallic precursor (MP) method.

We have developed a process for manufacturing long-length, high filament count, superconducting oxide - metal matrix composite tapes from metallic precursors. A large number of 40 cm long tapes with average critical current densities of 6 kA/cm^2 at 77 K in zero field have been made, demonstrating the scalability of the process. A prototype multi-strand conductor made of these tapes has a critical current of 240 A at 77 K in self-field over a 9 cm measured length.

Although the feasibility of a metallic precursor process for forming HTS/Ag composites has been demonstrated for quite some time [7-17], the process had not been extended to the fabrication of multifilamentary composite tapes. Previous work has been focused on the formation of superconducting oxide - silver composites from melt spun metallic precursor ribbons in both the (rare earth)-Ba-Cu-O [7-15] and Bi-Sr-Ca-Cu-O systems [16,17]. The properties of single core, silver sheathed wires made from mechanically alloyed Y-Ba-Cu precursors have also been reported [13]. Here we report on the properties, particularly the promising mechanical properties, of high-filament count Bi-2223 oxide - silver composite tapes prepared by the metallic precursor process.

II. THE METALLIC PRECURSOR PROCESS

The process for fabricating multifilamentary oxide - metal matrix composite wires from metallic precursors is illustrated in Fig. 1. An alloy of the elements corresponding to the desired cationic HTS composition is sheathed in silver, and the tape is formed by standard deformation processing techniques. The ductility of the metallic state gives a significant advantage, as compared to the OPIT process, in processing large billets, and in the multilevel stacking and deformation required for high filament-count composite tapes. Once in tape form, the filaments of the metallic precursor - silver composite are oxidized and reacted to form the oxide superconductor composite. This is made possible in part by the remarkably high diffusivity of oxygen through the silver matrix.

The Multifilamentary Metallic Precursor Process

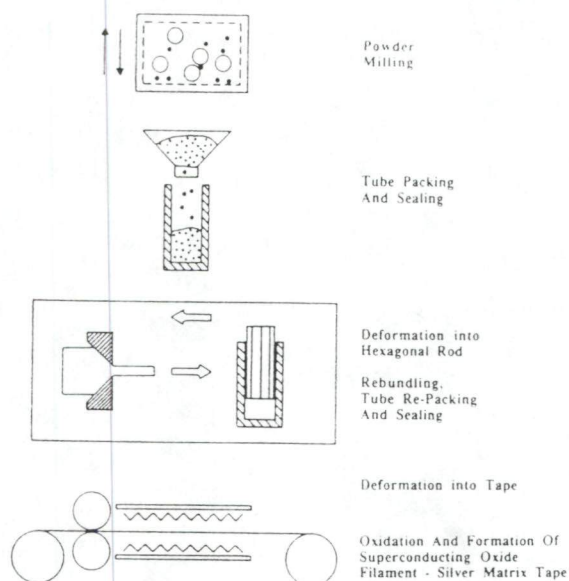


Fig. 1 Overview of the metallic precursor method for fabricating multifilamentary superconducting oxide - silver composite tapes

Although the metallic precursors have commonly been made by the rapid solidification of molten alloys, the method used in this work is mechanical alloying - a technology originally developed for making high-strength structural alloys [18]. The atomic-scale homogeneity yielded by mechanical alloying allows for novel reaction paths to be exploited, without the problems arising from long range segregation and chemical inhomogeneities.

In the Bi-2223 system, a homogeneous Pb-Bi-Sr-Ca-Cu powder of the desired Bi-2223 composition is prepared by mechanical alloying. The alloy powder is packed and sealed in a silver can that is then formed into a hexagonal rod. Cut pieces of the rod are stacked into a multi-rod bundle that is again packed into a can and formed into a hexagonal rod. This process can be repeated several times. In the final step, the can is formed into tape, rather than the hexagonal rod. 703 and

9583 filament tapes can be readily made using double and triple stacking respectively. The latter filament level is well beyond the present capabilities of OPIT technology. Cross sectional area reduction ratios of 100:1 are routinely achieved in each cycle, resulting in tapes with very uniform precursor filaments that are 5 μm or less in thickness.

The microstructures of a typical 9583 filament precursor tape are presented in Fig. 2, showing the excellent deformation uniformity possible with the above-described technique.

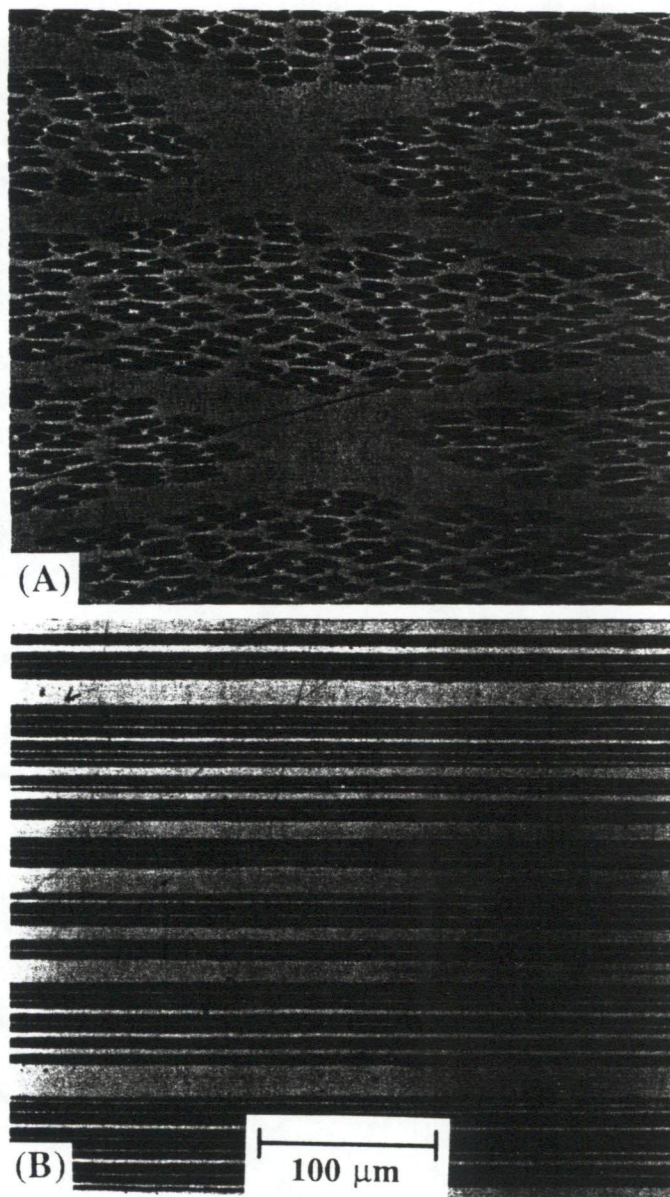


Fig. 2 Short transverse (A) and longitudinal (B) sections of a Pb-Bi-Sr-Ca-Cu alloy filament - silver matrix composite tape containing 9583 filaments (optical images)

Upon suitable oxidation and thermal-mechanical processing, average filament critical current densities of up to 7.5 kA/cm^2 in zero field at 77 K have been achieved in 40 cm lengths. This electrical performance is at a level of interest for

initial prototype applications. As a first step, the 30 cm long prototype multi-strand conductor displayed in Fig. 3 has been constructed from tapes made by the metallic precursor process. The transport critical current over a 9 cm gauge length is 240 A at 77 K in self field, corresponding to an average critical current density of 6 kA/cm². The tapes are approximately 0.011 cm thick and they contain 259 filaments.

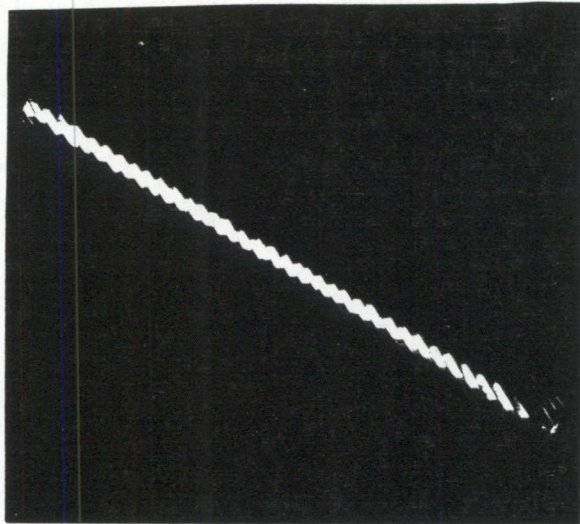


Fig. 3 A 30 cm long prototype multi-strand conductor comprised of Bi-2223 oxide filament - silver composite tapes made from metallic precursors

Because of the special advantages of the metallic precursor tapes in the areas of mechanical properties and high filament count configurations, the rest of this paper is on the mechanical properties and strain tolerance of high filament count, HTS/Ag composite tapes made from metallic precursors.

III. MECHANICAL PROPERTIES

A. Model Of Tensile And Bending Properties

The effects of tensile and bending strain on the critical currents of OPIT Bi-2223 multifilament - silver composite tapes have been reported for several filament configurations and counts [1, 2, 6, 20] and various J_c levels. Typically, in a single-bend test, the critical current is virtually unaffected up to a critical strain ϵ^* . At ϵ^* the critical current begins to decrease rapidly. However, the decrease becomes progressively more gradual as strain is increased beyond ϵ^* .

In perhaps the simplest model of bend effects, one assumes that the superconducting oxide filaments on the tensile side of the tape fracture in tension at some critical strain such that they can no longer transport supercurrent along their entire lengths. One also assumes that critical current is unaffected up to the critical strain. If the filaments are uniformly distributed within the ribbon of thickness $2S_r$ starting at distance $S_m = S_r - S_0$ from the surface as illustrated in Fig. 4, then eqs. 1 to 3 are readily derived to describe the normalized critical current

decrease I/I_0 for single (S.B.) and double (D.B.) bends to tensile-side surface strain $\epsilon = S_r/R$.

$$I/I_0 = \frac{S_r \epsilon^*}{2S_0 \epsilon} + \frac{1}{2} \quad \text{Single Bend} \quad (1)$$

$$I/I_0 = \frac{S_r \epsilon^*}{S_0 \epsilon} \quad \text{Double Bend} \quad (2)$$

$$I/I_0 = 1 \quad \forall 0 \leq \epsilon S_0 \leq \epsilon^* S_r \quad (3)$$

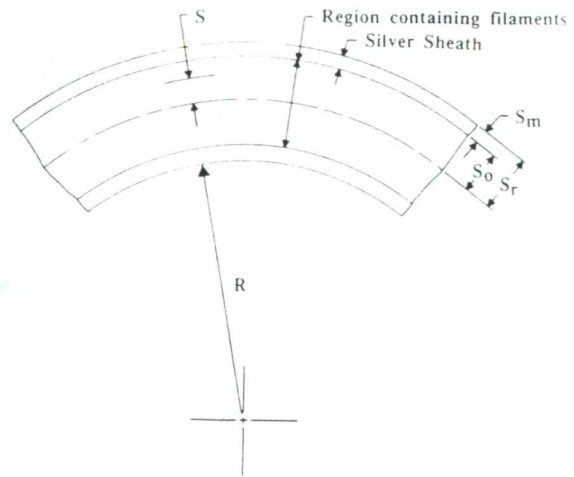


Fig. 4 Schematic of a bent superconducting oxide filament - silver matrix composite tape

These relations incorporate the assumptions that only the tensile side of the tape is damaged by a bend, and that the zero-strain plane is on the center-plane of the tape (e.g. there are no silver work hardening effects and the composite properties are center-plane symmetric). As a result, the additional critical current decrease incurred by the second, reverse bend to strain ϵ in the double bend doubles the decrease incurred by the single bend. If damage occurs to both the tensile and compressive sides with critical filament strain ϵ^* , then eq. 2 describes the decrease arising from a single ribbon bend to strain ϵ .

It is evident by inspection that eqs. 1 to eq. 3 yield a curve-form very similar to published curve-forms for the bend properties of OPIT Bi-2223 multifilament composites [2, 6, 20]. However, in this model, the single bend approaches $I/I_0 = 0.5$ asymptotically and the double bend approaches $I/I_0 = 0$ asymptotically. These asymptotes are not realistic for very large strains where metal work hardening dominates and center-plane symmetry in properties is lost. The relations are likely, however, to be valid for relatively small strains past ϵ^* .

The tensile-side surface strain criterion ($\epsilon = \epsilon^* S_r/S_0$) in eq. 3 for the onset of critical current decrease exceeds the critical strain ϵ^* required to fracture a filament in tension by the factor S_r/S_0 arising from the geometry associated with having no filaments in the surface region of the tape. The oxide filament distribution therefore affects the relationship between bend

strain and critical current degradation. If all the filaments are in the vicinity of the tape center-plane, then S_f/S_0 is large and the ribbon can be bent to much smaller radii (larger surface strains) without critical current decreases. However, the oxide fill factor (and I_c) is severely compromised.

B. Sample Preparation And Measurement Technique

Composite tapes containing either 703 or 9583 metallic precursor filaments were made by the method described in Fig. 1. After oxidation, they were processed in a manner similar to the conventional deform-and-sinter method used in OPIT, yielding tapes with nominal cross sectional dimensions of 0.02 cm x 0.41 cm. The oxide volume fractions were 0.09 and 0.13 for the 703 and 9583 filament configurations, respectively. X-ray diffraction showed that the primary phase was 2223, with the main secondary phases being 2212 and CuO. The micrograph in Fig. 5 illustrates the longitudinal structure of a single filament.

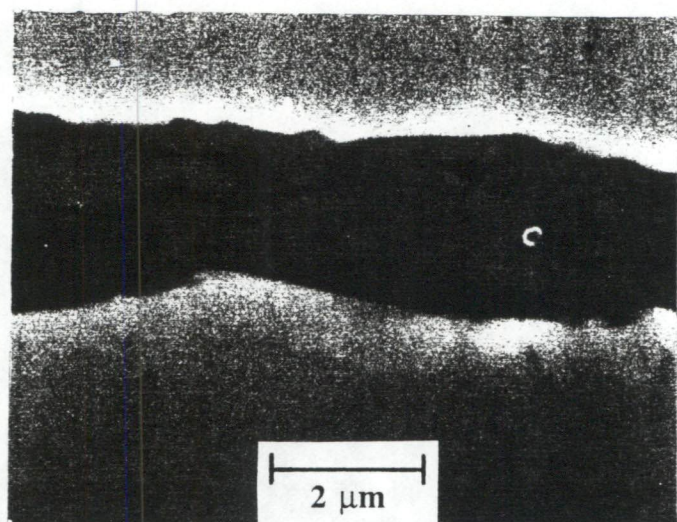


Fig. 5 Longitudinal cross section of a superconducting oxide filament in the 703 filament composite after processing (secondary electron image)

Approximately 10 cm lengths of each tape were strained using a standard tensile-testing machine modified such that critical currents were measured *in-situ* at 77 K as a function of tensile strain as illustrated in Fig. 6 (see also Ref. 2). A strain gauge extensometer with a 10 μm resolution was used to measure strain over a 2.5 cm gauge length. The same gauge length was used to determine the sample critical current. At small strain intervals, the current was ramped in small increments until the voltage far exceeded the equivalent 1 μV/cm point in the $I - V$ relation. The tangent between (I, V) points straddling the voltage criterion was obtained from a curve fit and the critical current was obtained as the extrapolation of the tangent line to $V = 0$ (the "offset criterion" [1]).

In the bend tests, the critical currents of 5 cm lengths were determined at 77 K using a 1 cm gauge length and the above criterion for critical current. Each length was then bent at

ambient temperature in one direction to a certain strain and straightened. The sample critical current was again determined. Some samples were then bent at ambient temperature in the reverse direction to the same strain as the first bend. After straightening, the critical current was again measured.

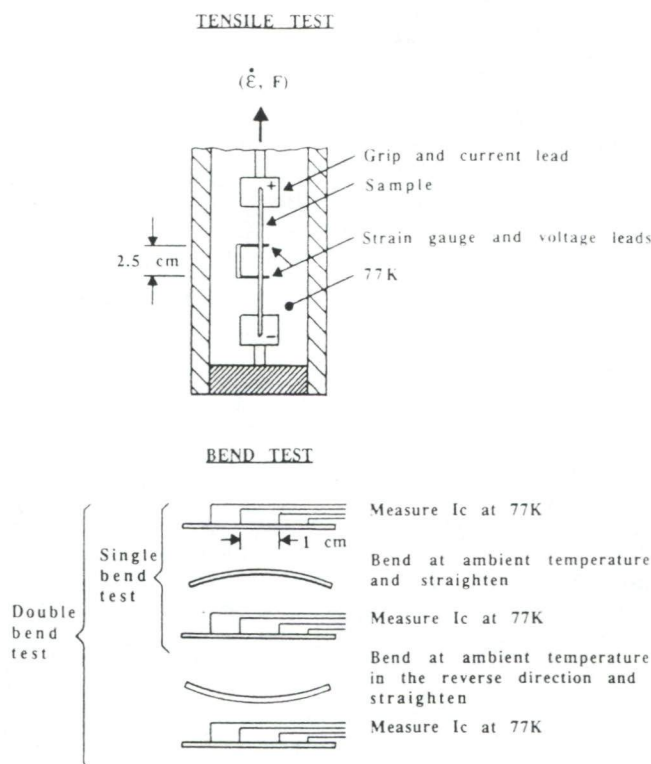


Fig. 6 Schematic of the bend and tensile test methods

C. Tensile Strain Results

The typical tensile properties of both the 703- and 9583-filament composite tapes are presented in Fig. 7. The critical current stays essentially constant up to an average strain of about 0.6%, followed by an initially rapid decrease to about 1/2 the zero-strain critical current values. Further increases in strain to 4% then lead to a gradual decrease in the critical current.

A 0.6% critical tensile strain is superior to results reported so far for OPIT multifilamentary wires where levels up to only 0.3% have been reached [2, 20].

The strain at the onset of the rapid decrease is the critical strain ϵ^* at which we assume a major fraction of the filaments are damaged sufficiently to reduce the critical current to about 1/2 of its original level. The remarkably gradual subsequent decrease to near-zero critical currents may be due to one of three effects: (1) the filaments fracture in a way that allows some supercurrent transport past their elastic limit, (2) the filament elastic limits to catastrophic failure are highly variable with respect to strain, and, (3) the 1 μV/cm offset voltage criterion used to measure critical current is not sensitive to shunting around cracks through the silver from

one filament to the next at the 2.5 cm gauge length used. This latter effect can be tested by increasing the gauge length or the sensitivity of the voltage measurement. However, a simple analysis of shunting through the silver yielded an ϵ^{-1} dependence of I/I_0 that went to zero considerably more rapidly than the observed decrease.

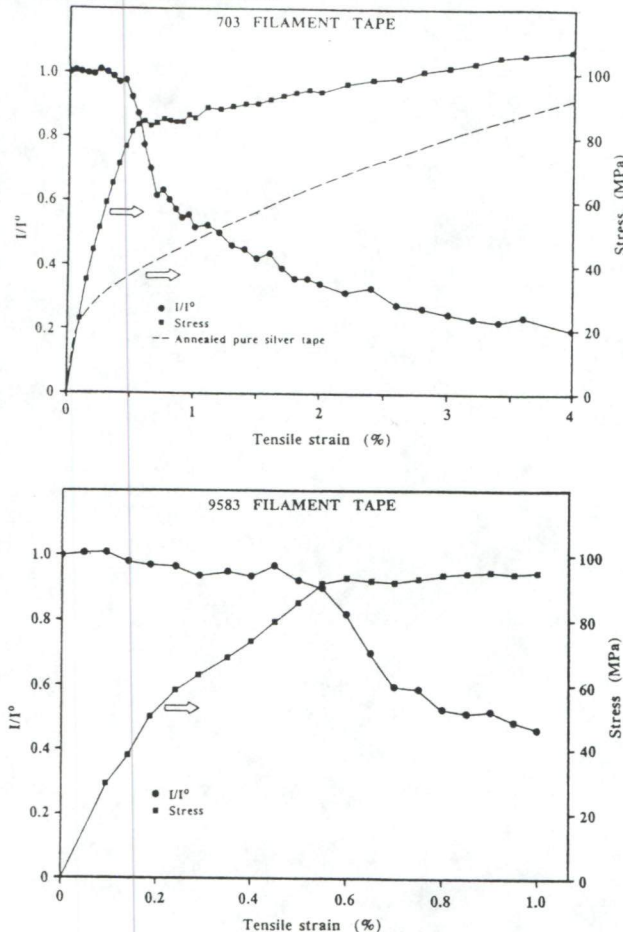


Fig. 7 Variation of normalized critical current and stress with respect to tensile strain for the 703 and 9583 filament samples at 77 K ($J_0 = 3 \text{ kA/cm}^2$)

The stress - strain relationships in Fig. 7 for the 703- and 9583-filament samples demonstrate that the composite tape begins to flow plastically at the critical strain ϵ^* . This is consistent with the behaviour of a brittle filament - ductile matrix composite in which the filaments are strained to their elastic limit. Further strain in such a composite is accommodated by filament fracture and a small amount of local crack separation that strengthens the ductile medium over some length scale by work hardening. With more strain, the ceramic filament fractures at a new region away from the work hardened area of the previous fracture. The macroscopic flow stress therefore increases very gradually with respect to strain past the elastic limit of the filaments.

The average slopes of the stress strain curves up to the constant flow stress regime yield moduli that are comparable to the modulus of silver [21]. However, the nonlinearity in this region of the stress strain curves as well as considerable

sample-to-sample variability introduces significant uncertainty into the accuracy of the composite modulus value.

A comparison of the stress - strain relations for silver and the composites in Fig. 7 demonstrates that the superconducting filaments strengthen the ribbons by a factor of roughly 2.5 at the onset of plastic deformation. The degree of strengthening by the oxide filaments is likely to depend on filament size, distribution, crystallographic texture and phase content.

D. Bending Strain Results

The results in Fig. 8 demonstrate that the 703- and 9583-filament composite tapes behave similarly in both single and double bends. Typically, the critical current stays constant to about 0.7% tape surface strain, followed by an initially rapid decrease. However, the rate of decrease diminishes, with the single- and double-bend normalized critical currents approaching 0.75 and 0.55 respectively at 1.6% strain.

These results are comparable to the best results reported so far, on 1296-filament OPIT tapes [6]. However, a valid in-depth comparison of wire performance quoted in published data to the present work could only be made if the filament distribution within the tapes were similar, or at least known. The geometric correction (S_r/S_0) for tensile side critical strain at the outer limits of the tape region containing filaments could then be used to normalize the data.

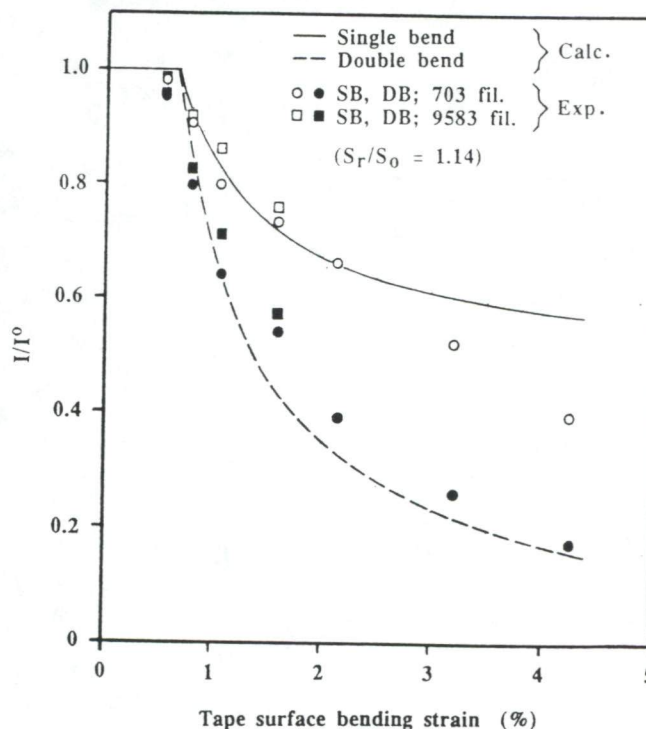


Fig. 8 Variations of normalized critical currents with respect to tape-surface bend strain ($J_0 = 3 \text{ kA/cm}^2$) for single and double bends

With an average critical tensile strain of 0.6% from the tensile tests for the 703 filament tapes, eqs. 1 and 2 yield the curve-forms in Fig. 8 for a comparison to the experimental

bend behaviour. There is good agreement between the experimental and calculated strain dependences. Deviations between the model and the experimental relations are likely to result from the gradual critical current taper beyond the critical strain rather than the assumed sudden decrease to zero critical current at the critical strain, as well as from silver work hardening and loss of center-plane symmetry in properties.

E. Microstructures And Failure Analysis

Single- and double-bend samples, as well as samples tested in tension, were mounted longitudinally, ground and polished for microscopic failure analysis using optical and scanning electron microscopy.

The micrographs of a 9% tensile-strained 703 filament tape in Fig. 9 display cracks that follow irregular paths through the aligned grains of the filaments. The grains apparently sheared along their basal planes, allowing cracking at different locations through their thicknesses and separation of the disconnected grain pieces by the telescoping mechanism illustrated in Fig. 10.

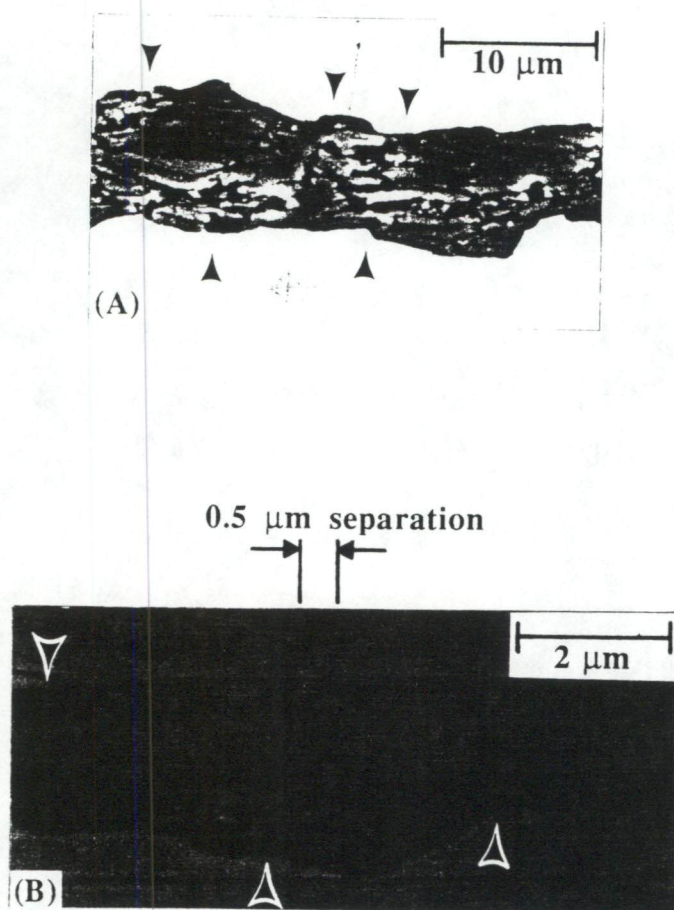


Fig. 9 Cracks (marked with arrows) in 9% tensile-strained 703-filament ribbons (A) view showing the nature and frequency of fracture (secondary electron image), (B) view of basal-plane sheared and telescoped region (backscattered electron image)

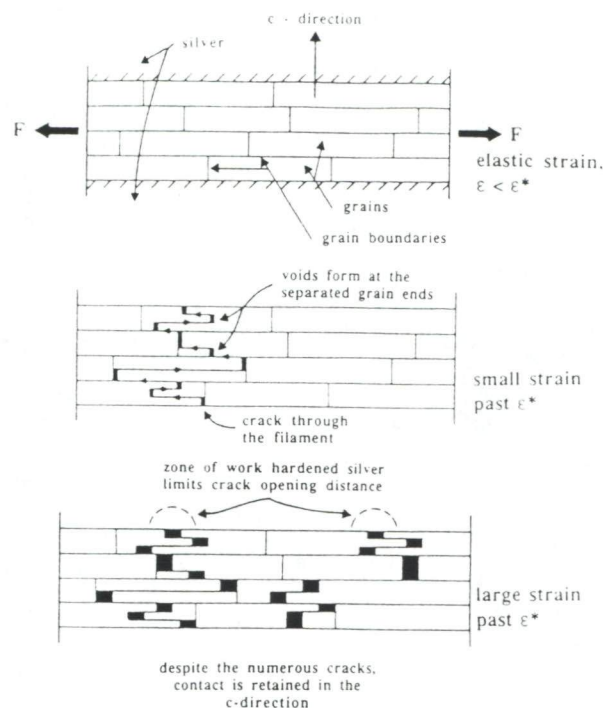


Fig. 10 Basal plane shear and telescoping grain mechanism of well-textured Bi-2223 oxide filament deformation in tension to large strains

Cracks did not open in the direction perpendicular to the filaments, even though the separation (and consequent voids) at grain ends (Fig. 9b) required extensive basal plane shear and sliding. It is evident by inspection of Fig. 9a that the sum of void widths along the filament add up approximately to the macroscopic 9% strain of the composite. Local work hardening of the silver would accompany the local strain required to form these voids, distributing the strain to other, less strained regions of the tape and preventing gross local separation of the filaments. This may explain in part the gradual taper to zero critical current at large strains because the filaments, although consisting of sheared grains, could possibly still transport supercurrent by tunnelling across the chemically unbonded, but physically contacting, sheared regions. Magnetic field measurements on variable gauge lengths may aid in resolving the nature of supercurrent transport through these highly strained composites.

Micrographs of typical bending-induced cracks are illustrated in Fig. 11. The predominant damage seen in all samples bent beyond the critical strain consisted of cracks extending part way or completely through the filaments, with no correlation to adjacent filament cracking. Cracks were often quite difficult to resolve with the SEM, due to openings typically less than $0.1 \mu\text{m}$. The keying seen between separated regions provides the best evidence for crack propagation through the filaments because voids and second phases do not form these structures. Although the cracks and separation are less extensive in the bent samples than in the tension tested samples, both strain modes yielded cracks with essentially the same morphology.

In well-textured filaments, cracks tend to propagate through the superconducting oxide grains in an irregular manner (Fig. 11a) typical of the fracture of such fibrous composites as wood. In regions of poor texture the cracks followed a more direct route. In regions containing second phases, the cracks often followed the second phase particles through the filament. In some instances, the crack propagation had obviously been stopped by another superconducting oxide grain of slightly different orientation (Fig. 11b) resulting in partial cracking of the filament. Cracks were not seen in the compressive sides of single-bend samples, while cracks were found in both sides of double-bend samples.

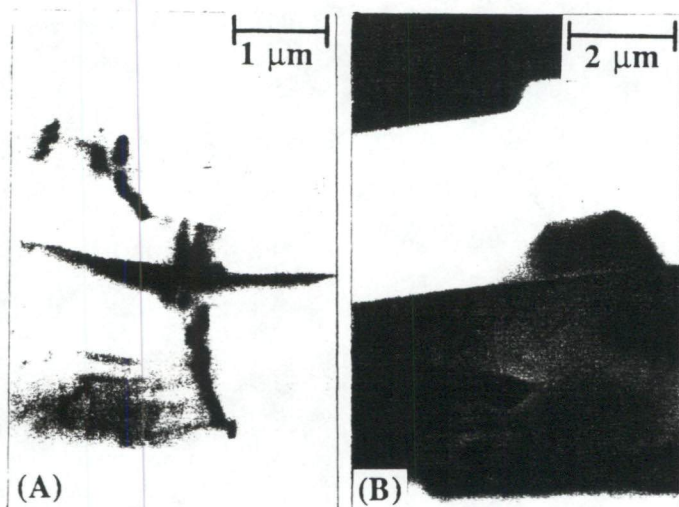


Fig. 11 Micrographs of cracks in bent superconducting 2223 oxide filament - silver composites. (A) shows a fibrous crack through a filament (secondary electron image), (B) a partial crack ending at an off-angle grain (backscattered electron image)

IV. SUMMARY

The properties of Bi-2223/Ag composite multifilamentary tapes prepared by a metallic precursor process are described. Critical current densities of up to 7.5 kA/cm^2 at 77K in zero field have been measured in 40 cm length tapes. A 30 cm prototype multi-strand conductor containing these wires has a 240 A critical current at 77 K in self-field over a 9 cm gauge length. This corresponds to an average critical current density of 6 kA/cm^2 in the 259 filament tapes.

The 77 K tensile and bending properties of tapes made from metallic precursors containing 703 and 9583 Bi-2223 oxide filaments were determined. The initial flow stress of the composites was four times the flow stress of similarly-processed silver, indicating considerable strengthening of the tape by the oxide filaments. The plastic flow regime started at about 0.6% tensile strain, which corresponded to the strain where critical current first started to decrease. The critical currents past this critical strain decreased rapidly to about 1/2 their initial values, followed by very gradual decreases with strain increases to 4%.

Overall, the initial effect of tensile strain on critical current is characteristic of a critical strain mechanism. However, the gradually decreasing critical current beyond the critical strain in the tensile measurements implies that the filaments are damaged nonuniformly by applied strain, with some filaments remaining intact (or partially intact at least) out to much larger strains. The microstructures observed support this mechanism. The aligned grains of a well textured filament accommodate large tensile strains via a basal plane shearing and telescoping mechanism that does not introduce large discontinuities in the filaments. Rather, small voids are formed at the ends of the sheared grains as they slide past each other.

In bend tests, the effect of bend strain on critical current correlated well to the tensile test results. Typically, critical currents remained constant to about 0.7% strain, followed by an initially rapid but tapering critical current decrease as bend strain was increased to 4%. Even at 1.6% strain however, the material retained 0.75 and 0.55 of its initial critical current in single and double bends. Damage was only found on the tensile side of single bend samples.

These results are very promising for the development of HTS wires and tapes with improved mechanical properties.

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DESIGN AND FABRICATION OF HIGH TEMPERATURE SUPERCONDUCTING FIELD COILS FOR A DEMONSTRATION DC MOTOR

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Abstract -- The design, fabrication & characterization of field coils for a DC motor operating at 77 K is described. The DC motor uses an iron core to impress the field from the stationary superconducting coils onto a conventional armature which is nominally at room temperature. The motor has a total mechanical power output of 25 W. The coils were fabricated from BSCCO ceramic superconductor using a react and wind process. Each coil was extensively characterized both in the motor configuration as well as individually. The tests indicate that robust superconducting coils can be produced using ceramic superconductors. The durability of these coils as illustrated by the testing of the motor shows that high temperature superconductors have reached a level of performance to be considered for demonstration motors.

I. INTRODUCTION

The 1987 discovery of high temperature superconductors (HTSC) with transition temperatures as high as 125 K, raised the prospect of new applications for superconductivity. New applications become feasible due to reduced cooling costs of HTSC at temperatures of 20-77 K as compared to previous low temperature superconductors that must be cooled with liquid helium (4.2 K). One potential application for HTSC is in high horsepower electric motors where superconductors in wire and coil form can be used to increase the motor power density and decrease the motor losses [1]. The operation of large electric motors accounts for 25% of the electricity use in the United States. These large motors are found in applications such as pumps and fans for power plants and refineries among other industrial applications. Increasing the efficiency of these large motors represents a significant annual energy savings. Synchronous motors with rotating superconducting field windings and normal conducting (copper) armature windings show great promise for efficiency gains.

In 1987 the Electric Power Research Institute (EPRI) contracted with Reliance Electric to investigate the use of HTSC in electric motors. This program included motor design studies as well as testing of HTSC solenoids from several vendors, including American Superconductor Corporation, to determine their performance in a simulated motor environment. Design studies indicate that synchronous superconducting motors can be reduced in size by 50% and have about half of the losses of a conventional

motor. The smaller motor size and higher efficiency are keys to the economic viability of these motors in utility and industrial applications. Achieving these size and efficiency targets requires superconducting wire with critical current density, J_c , of 10^5 A/cm² in a magnetic flux density, B , of 3-5 Tesla. Details of the motor design and construction are described elsewhere [2,3].

Along with motor design studies, the motor research program has concentrated on testing small coils using state-of-the-art HTSC wire. Since the delivery of the first coil in 1989, coil performance has been found to dramatically increase[1]. This improvement was a result of longer lengths of wire and higher critical current densities in the presence of a magnetic field.

A small DC motor using HTSC field coils has been fabricated by Sato et al [4] which is similar to the motor of the present study. However, in their study, there was no mention of the performance characteristics of the motor other than its ability to turn the armature. The effects of the AC flux imposed on the HTSC coils due to the turning of the armature is explored in the present study.

II. COIL FABRICATION

American Superconductor Corporation (ASC) has set as its mission the fabrication of conductors, coils and magnets for electrical power applications. For these applications, robust long lengths of high current capacity conductor is required. The above mentioned performance requirements for the large motor is typical of many electric power applications.

ASC practices two processes for conductor fabrication, both of which have delivered coils to Reliance for their DC demonstration motor. The metallic precursor process starts with the metallic constituents of the superconductor alloyed together in the required atomic ratio via a solid state alloying process. The alloyed powder is then packed in a silver billet and sealed. The sealed billet is then deformed into a wire or tape geometry as desired by conventional deformation techniques. Restacking of wires at intermediate stages in the process can be used to obtain a multi-filamentary wire if desired. The deformed wire is subsequently heat treated in an oxidizing environment converting the alloy therein into the desired ceramic superconductor filaments[5].

The Oxide-Powder-In-Tube (OPIT) processing method is also used to make superconducting wire and tape. In this process, superconducting oxide powder fabricated from a variety of processes is packed into silver tubes which are deformed by a combination of extrusion, drawing and swaging. The resulting wire is bundled and deformed again, into a tape geometry. A final heat treatment forms a continuous multi-filamentary superconductor.

The fabrication methods used by ASC result in a robust conductor capable of withstanding significant bending strain. ASC's characterization facility is capable of measuring the effects of bending and uniaxial strain on the electrical characteristics of the conductor. The standard bending test consists of bending a sample to a given strain level then reversing the bend before measuring the critical current. Our data shows that there is little degradation in the critical current for bending strains below 0.75% [5,6,7].

Coil	A	B
Inside Diameter (mm)	32	32
Outside Diameter (mm)	64	65
Coil Length (mm)	50	50
Number of Turns	326	338
Conductor Length (m)	47	50.4
Critical Current (77 K)	0.92	1.02
Self Field at I_c (G)	53	62

Table 1 -- Geometry and electrical properties of the coils. The critical current is based on an electrical resistivity criteria of $1.95 \times 10^{-9} \Omega\text{-cm}$.

The robustness of the conductor as fabricated by ASC, enabled the production of coils using a react and wind process. The OPIT process starting with PbBi-2223 powder was used to produce the conductor. An intermediate restacking operation resulted in a 19 filament tape conductor of 2.5 mm x 0.2 mm cross section having a 4:1 stabilizer to superconductor ratio.

After the final heat treatment of the tape, the conductor was insulated with braided ceramic fibers. The insulation is similar to that used on Nb₃Sn wire and was applied using a braiding machine. The insulated wire was then wound onto the mandrel with a coil winder. In each of these operations, the conductor was subjected to bending and tensile loads as well as twisting to a small degree. The specifications for the two coils used in the demonstration motor are presented in Table 1.

III. ELECTRICAL CHARACTERISTICS OF COILS

The critical current at 77 K was measured using a resistivity criteria of $1.95 \times 10^{-9} \Omega\text{-cm}$ which corresponds to 1% of the resistivity of copper at 77 K. The loadline for each coil is shown in Figure 1 superimposed on the short sample critical

current vs. magnetic field data. The critical current as measured in the coil geometry matches the expected values based on the short sample measurements. This indicates that the insulation and winding processes did not cause any measurable degradation in the performance of the superconductor. Prior to shipment of the coils to Reliance, they were cycled thermally from room temperature to 77 K a total of ten times. The critical current was measured during each cycle to 77 K. The critical current of Coil A decreased by 2% during the first two cycles and thereafter remained constant while the critical current of Coil B remained unchanged.

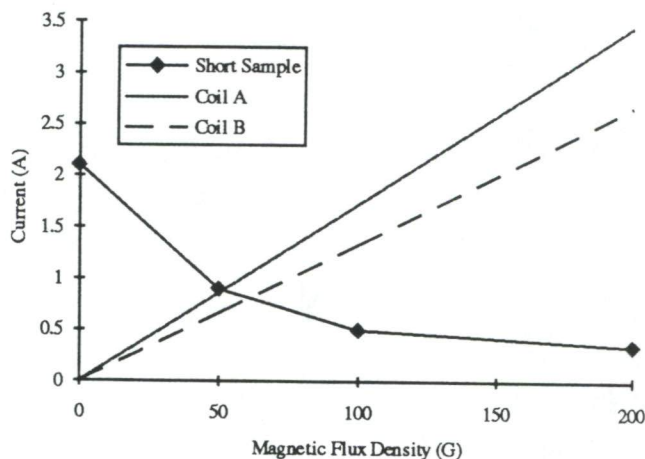


Figure 1 -- The coil loadline superimposed onto the short sample conductor performance shows no measurable effect of the braiding and winding operations on the coil performance.

After the coils were delivered to Reliance, the critical current of each was measured and confirmed. To test the coils with an external magnetic field the HTSC solenoids were placed on a magnetic steel post located between the field poles of an electromagnet as illustrated in Figure 2. Each field pole spanned 120 degrees of the HTSC solenoid outer circumference and was in close proximity to the solenoid conductors. In this test fixture the external field is directed radially with respect to the HTSC solenoid axis and perpendicular to the flat tape side of the solenoid conductors. All tests were performed with the HTSC coil (and part of the electromagnet core) immersed in liquid nitrogen.

As each HTSC coil is energized in this test fixture, it magnetizes the steel post along its axis. The combination of this self field and the bias field emanating from the pole shoes creates a non-uniform magnetic field distribution throughout the coil winding which is similar to the magnetic field distribution HTSC coils will be exposed to in a motor application. The peak magnetic field in the coil conductors was used to characterize the coil wire performance. This peak field value generally occurred at the outer diameter of the HTSC solenoid.

IV. DC MOTOR PERFORMANCE

The two solenoid coils have been used as field coils in a 25 W DC motor. Figure 4 shows a photograph of the motor. The HTSC field coils are connected in series and are mounted on the laminated iron field core. They are cooled by immersion in a liquid nitrogen tank. The normal conducting armature (with copper wire) with its brushes and commutator stand above the liquid nitrogen level. The armature shaft is connected to a fan of known load characteristics for loading purposes. The motor is run with independent control of the armature voltage and the field current.

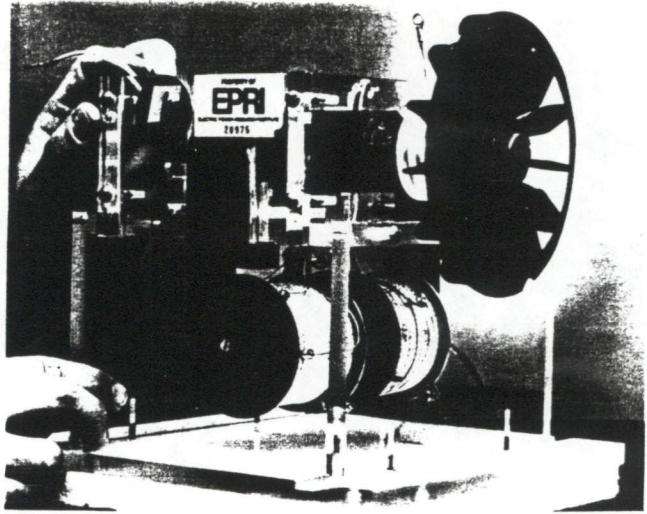


Figure 4 -- The assembled DC motor showing the coils on the bottom.

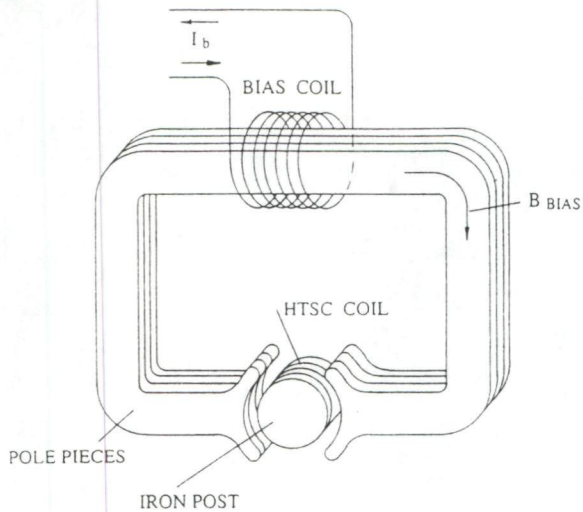


Figure 2 -- A schematic of the apparatus used to impose an external magnetic field normal to the flat surface of the tape in the coils.

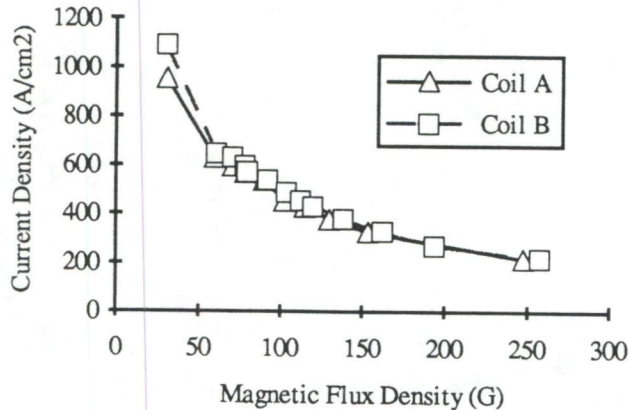


Figure 3 -- Performance of the two solenoid coils as a function of magnetic flux density imposed by an external electromagnet.

The DC critical current (obtained from a standard four point measurement) was measured as a function of DC coil current for a range of applied bias magnetic fields. With the non-uniform magnetic field distribution described above, the wire resistivity varies throughout the coil. An average resistivity of $1.95 \times 10^{-9} \Omega\text{-cm}$, obtained from the coil terminal voltage measurement, was used to define the superconducting transition and determine coil critical current density.

Figure 3 shows curves of measured wire performance for the two solenoid coils in applied DC magnetic fields. The low field values (below 50 Gauss) are obtained from air core test data. All other data is with the coil in the bias field test fixture. Both coils have a critical current density that is a strong function of the peak magnetic field and is consistent with the short sample data in Figure 1.

When the armature power supply is turned off, the armature is at zero speed and the measured field coil DC V-I curves are as shown in Figure 5. When the armature supply is turned on, the armature rotates and introduces some AC flux into the field core due to armature slotting effects. The AC field flux induces AC voltage into the field coils. A passive RC filter was used to filter out this AC voltage in order to measure the DC HTSC coil V-I data shown in Figure 5. Notice that with the motor running, the DC coil voltages are higher at each field current value. As the motor speed increases the DC HTSC coil voltage increases for a constant coil current. It is suspected that increased AC magnetic field magnitude and frequency on the coil conductors due to armature rotation causes increased coil losses that show up as a higher DC terminal voltage.

Also shown in Figure 5 are data points corresponding to increasing armature voltage with the HTSC field coils excited at 0.5 A. As the armature voltage increases, the fan speed increases. At the maximum armature voltage of 24 V, the fan speed is 2500 rpm and corresponds to an output power of 25 W.

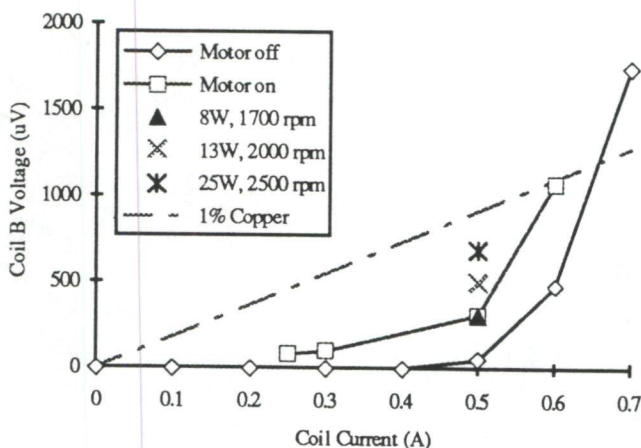
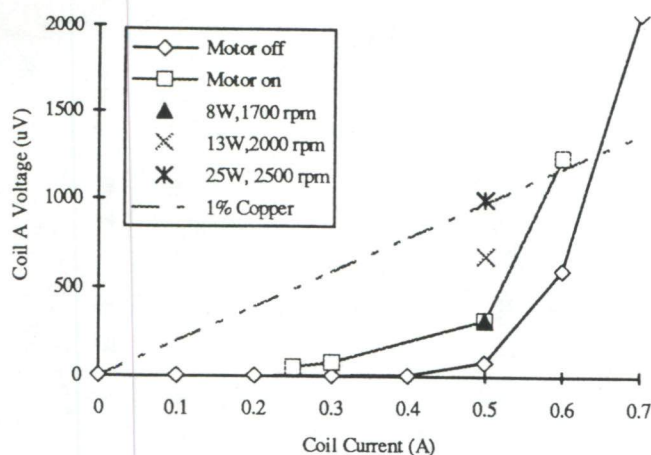


Figure 5 -- The measured I-V curves for each of the field coils are affected by the AC flux induced by the rotation of the slotted iron core armature.

V. CONCLUSIONS

High temperature superconducting coils in high horsepower electric motors have the potential to reduce motor size and losses compared to conventional motors built today. Present day HTSC wire performance is progressing so that small solenoid coils with tens of meters of wire can be constructed. A pair of HTSC solenoids that were built as field coils for a 25 watt DC motor are described herein. The coil wire was of the react-and-wind type and was able to withstand the rigors of machine assisted coil winding.

Over a time span of 12 months, the two coils have survived almost 50 thermal cycles from room temperature to liquid nitrogen temperature without significant degradation of their superconducting properties. They have been used as the field winding of a 25 watt demonstration DC motor and have been shown to remain superconducting with the motor operating at its rated output power.

Advancement in HTSC wire and coil technology improved dramatically in 1991. The react-and-wind technology with rugged HTSC wire will allow complex coil shapes for future

HTSC motor prototypes to be fabricated. As wire and coil performance improves, larger motor prototypes will be built with the ultimate goal of building high horsepower synchronous motors with HTSC field windings.

ACKNOWLEDGMENTS

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APPLICATIONS OF HIGH-TEMPERATURE SUPERCONDUCTING COILS AS INDUCTORS IN SWITCHING POWER SUPPLIES

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Abstract — Chokes and inductors made from high-temperature ceramic superconducting (HTS) wires offer a new range of design and performance possibilities for high-power converters by making possible near loss-less inductances. Such power supplies can operate efficiently at low frequencies, thereby reducing semiconductor switching losses, decreasing heat sinking requirements, and lowering demands on circuit capacitors. Use of HTS inductors results in power converters up to 50% smaller in size in multi-megawatt installations, while still achieving considerably improved operating efficiencies and greatly simplified heat rejection. The installed cost may be 30-50% less than for conventional designs.

I. INTRODUCTION

Switching power supplies (SPSs) have become commonplace. They are used as DC sources in computers and other equipment applications because they are efficient and relatively inexpensive for their performance. An SPS with modern semiconductor devices is attractive because it is easy to rectify mains power, invert the DC to high frequency AC (1-500 kHz) using solid state switching devices, and convert the high frequency back to DC. The attractiveness of this procedure lies in the ease of filtering the high frequency, full wave source with modest-sized inductors and capacitors to produce a low ripple DC source. Achieving comparable ripple-free DC directly from the mains frequency (50-60 Hz) requires much larger capacitors and heavier chokes [1]. A similar high-frequency filtering approach is widely used in the design of class D amplifiers, three-phase cyclo-converters, Ćuk converters, and the like.

However, despite their advantages at low power levels, several challenges face the SPS designer at power levels greater than about 25 kW. The reasons are found in an analysis of the loss behavior typical of SPSs. At low frequencies, the inductor and choke must be so

large as to be uneconomical; the natural tendency, therefore, is to choose a semiconductor switch (power MOSFET, thyristor, GTO, IGBT, etc.) that operates at very high frequency (1 MHz and above have been tried). Unfortunately, at high frequencies, the switching losses in the power devices and switching diodes rise sharply and dominate the conversion losses. The performance demands on the capacitor at high frequency become large, as well. High switching losses result in requirements for extensive heat sinking and heat rejection. Moreover, high temperatures significantly degrade reliability and life expectancy.

Power supply designs have evolved from the perspective that non-ideal devices with resistances in undesirable places are unavoidable and, especially, that losses in inductors (chiefly I^2R_L) always exceed the losses in capacitors (I^2ESR , the "effective series resistance," dielectric losses). Thus designs implicitly favor small inductors and large capacitors. The larger the inductor the more this maxim appears true. However, the advent of flexible wire employing high-temperature superconductor filaments makes it possible to question the conventional wisdom. For example, large inductors are usually wound on an iron or ferrite core to increase L without paying the cost of high I^2R losses. But, in the absence of resistive losses, the core--and its associated hysteretic, core eddy-current, and skin-effect losses (which become important at higher frequencies)--can be eliminated.

Using chokes made from high-temperature superconducting (HTS) wire in SPSs would offer several advantages and incur several costs. The advantages are significant: minimal I^2R_L losses no matter how large the inductance; no core losses since an iron/ferrite core is not required, high energy storage density; smaller physical size and weight; reduced component heating; easier waste heat rejection; smaller, less expensive capacitors; higher conversion efficiency; and

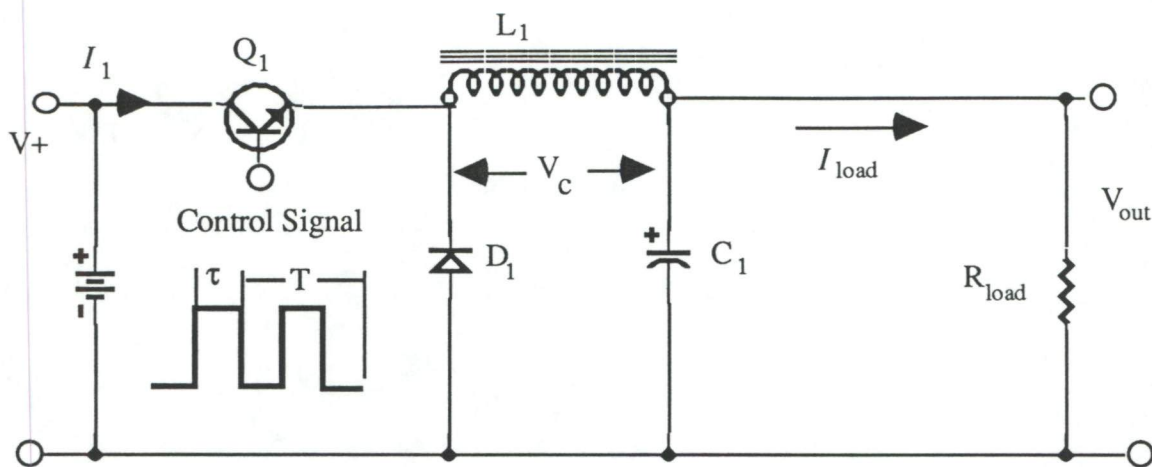


Fig. 1. Simplified schematic of the switching and output stage of a switching power supply.

reduced surge-induced sags from intermittent loads, *e.g.*, arc welders or motor controllers. The penalties involve the cost of refrigeration, including the residual AC/eddy-current and skin-effect losses in the inductor.

II. LOSSES

High power SPSs typically operate with efficiencies in the 85-95% range. At 100 kW this represents losses of 5-15 kW. Small losses occur in the series and parallel resistance of the capacitor, the diodes's transients, and other components. However, more than 90% of all losses can be assigned to four factors: the transient losses of the switching transistor (72%), the forward drop losses of the transistor (9%), the core losses of the inductor (7%), and the I^2R conductor losses of the inductor (2%) [2]. These losses have been valued at as much as \$6000/kW in HVDC systems over the lifetime of the equipment [3].

Switching losses vary approximately linearly with the frequency with a slope as high as 250 watts/kHz for a 100 kW supply [2], and as the largest loss component represent the best place to look for savings. Semiconductors with excellent high frequency characteristics are also much more expensive, and the heat they produce incurs additional penalties in heat sinks and blower fans to keep them cool. Reducing the switching frequency an order of magnitude (say, from 30 kHz to 3 kHz), would reduce the switching losses a factor of 10 to only 0.72% of total power.

The single-stage filter on this supply scales as $\omega^{-2} = LC$. Such a reduction in ω requires the $L \cdot C$

product to be 100-fold larger. If C is scaled from a value appropriate to 20 kHz ($\approx 2000 \mu\text{F}$), this would require 0.2 F of capacitance. An oil-filled 30 μF capacitor rated for AC at 600 V weighs about 1 kg and costs $\approx$ \$27. Thus to obtain equivalent filtering at the lower frequency would require 6600 units at a cost of \$180,000 and weight of 6600 kg!

Similarly, an attempt to scale a conventional inductor to 500 mH at 200 amps would result in a choke 80 cm in diameter, 1 m long of 4200 kg that dissipates at least 3 kW in I^2R losses and requires water cooling. Core losses would add almost 1 kW, and the behemoth would cost about \$200,000. These considerations are sufficient to show why engineers are willing to tolerate the switching loss penalties of higher frequencies.

III. SUPERCONDUCTING CHOKES

These obstacles can, however, be overcome using HTS superconducting coils. A similar 0.5 H air-core choke for 200 amps would be 20 cm in diameter, 30 cm long, and weigh 32 kg with a maximum field of 3 T using HTS wire presently available (toroidal windings can eliminate fringe field problems). Such an HTS coil would have nil I^2R and core losses, and, with an integrated cryo-cooler for 25 K operation, has a projected system price of \$15,000 (or \$25,000 if toroidal coils are required). The power required for the cryo-refrigerator would be about 2.5 kW. With electricity at 6¢/kWh, the refrigeration costs amount to \$1300 annually.

Since 6.5 kW has been saved in switching losses and 1 kW in inductor losses, the

refrigerator adds back only 1/3 of the savings--resulting in a net benefit. The hypothetical 90% efficient power supply has been raised to 95%. Additional savings in cost and efficiency are realized from not having to scale up the heat sink, fan, and blower requirements, and from using less expensive semiconductors and other components. In addition, an SPS design based on an HTS choke will be substantially smaller in size and weight, and 20-40% less costly than conventional designs utilizing switching frequencies in the 20-100 kHz range. Another benefit arises from reduced RF generation at lower frequencies and, consequently, savings in construction of shielding.

A more detailed analysis shows that the breakeven point for a cryo-cooled HTS inductor occurs for SPSs near 50 kW. At lower powers, the refrigeration penalties outweigh the savings. However, the savings increase substantially for power levels above 100 kW. Savings also increase for 3-phase systems and for the inverter section of bi-directional cyclo-converters. The concept of the cryo-cooled inductor thus enables a major paradigm shift in the design of high power electronics.

An additional advantage may be gained by operating the entire electronics at cryo-cooled temperatures, since the initial investment in cryo-cooling provides cold surfaces and the capacity to integrate the entire system at little supplemental cost. Power MOSFETs appear to be the semiconductor of choice with power handling capability approaching the 10^3 kVA range at 77K [4]. MOSFETs operated at low-temperature have significantly reduced on-state losses, and a low switching-frequency reduces the switching losses substantially. Cryogenic capacitors are also available. Thus, while use of cryo-cooling for the semiconductors alone may not be justified, when a cryogenic environment is available for one component, it makes sense to think about cooling everything.

Although maintenance and component replacement may be more difficult in a sealed cryogenic system, the lower temperatures are likely to lead to reduced failure rates since thermal stress (85% humidity, 85% maximum values) is responsible for up to 70% of component aging failures [5]. Components can also be used more effectively because the need for temperature derating is eliminated; this results in cost savings.

Another benefit in some installations is that heat rejection is concentrated in the cryo-cooler, making a single point, which can be remote, where heat is removed. There is advantage in having no heating of the local environment and controlled heat rejection via air or water heat exchangers. Since semiconductor case temperatures must be limited to $<125^\circ\text{C}$, the low ΔT above ambient and spatially dispersed source make for relatively inefficient heat transfer. Concentrating the heat and rejecting it at a higher temperature means more efficient heat exchangers can be employed.

Finally, where the power density and, hence, heat production is such that water-cooled systems are now required, a cryogenically cooled design is especially attractive. Water-cooled systems are notorious for problems arising from corrosion, leakage, and condensation-induced shorts, problems that are constant threats to high voltage systems.

IV. CONCLUSION

Cryogenically cooled inductors, and, by extension, cryogenically integrated electronics appear to offer substantial design advantages in high power converters. Among these are cost reductions, improved performance, higher operating efficiencies, and reduced weight and volume.

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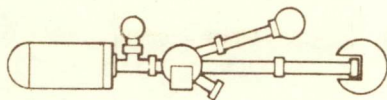
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The Honorable D. Allan Bromley
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Thanks for your letter for Pat Richard.

Sincerely yours,

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Co-Chairman

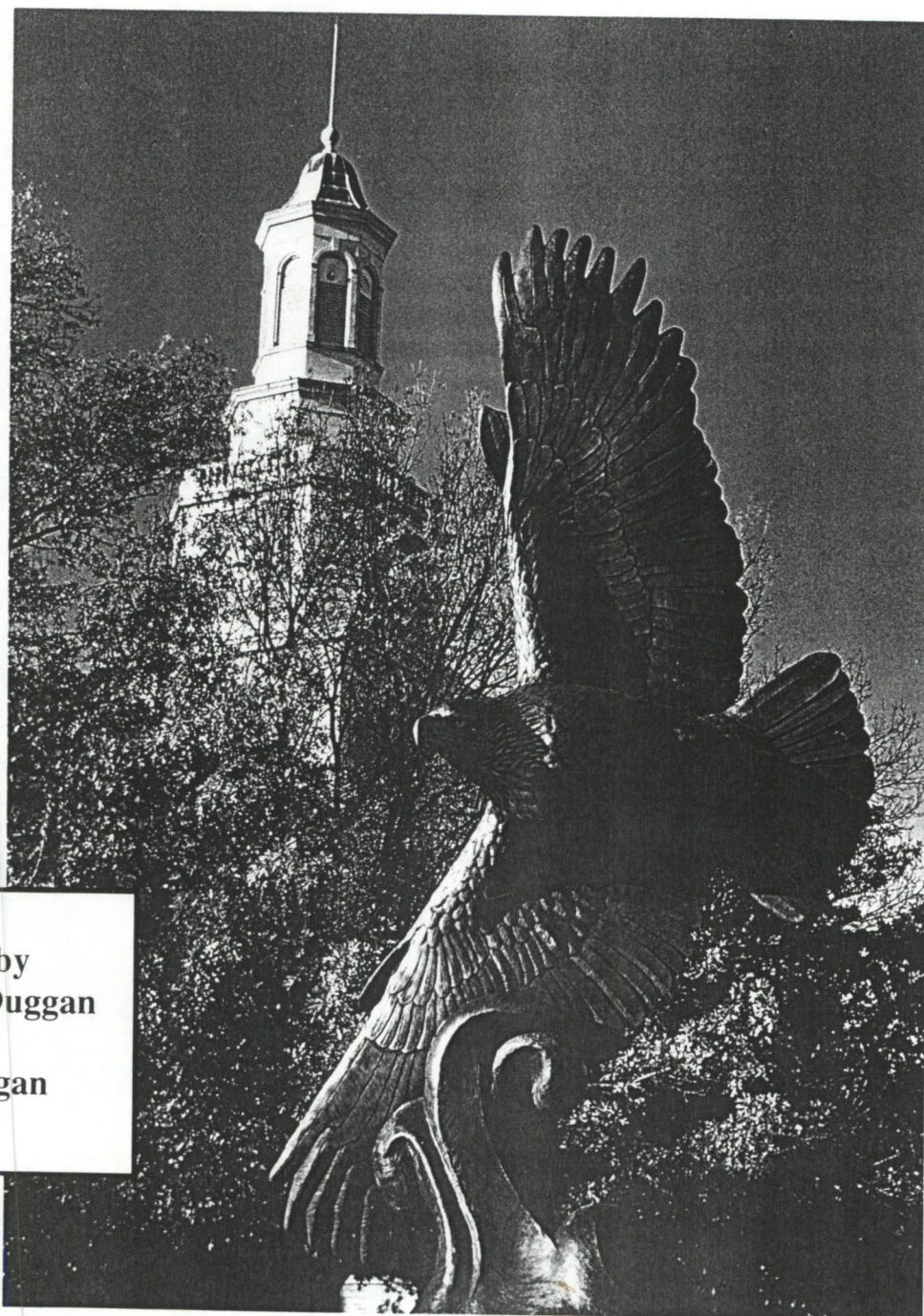
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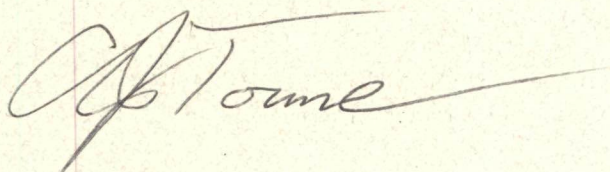
Dear Mr. Bromley;

Once in a generation an airplane comes along that changes everything. The hypersonic, Mach 18 X-30 National AeroSpace Plane is teaching us how to fly to orbit at \$1.00 a pound. Its technology will, after 2010, make flying to space like flying to Chicago.

Still, the House and Senate may kill this project that gives us the surest path to the spiritual and material bonanza of contact with the highest frontier, the next new world. The Senate Armed Services Committee has voted to say we can't afford this establishment of our grandchildren's prosperity. The X-30 National AeroSpace Plane gives a greater return on taxpayer's investment than any other use of the national seed-corn. Apollo did the same thing.

There is a still secret flight project to use a slower Mach 6 airplane to launch a small rocket carrying small payloads. The price improvement for this rocket versus ground-launched rockets is so great at Mach 6 that the social, practical and economic good of making one leap to space in a Mach 18 transport is being lost on some. Comparing the payload cost of a new dorsal missile to the untransport X-30 or transport progeny is like comparing the range economics across the Atlantic of the Short-Mayo Composite, used experimentally by Imperial Airways in 1938, with the DC-3, which had no payload at that kind of range, or the later DC-4.

Sincerely Yours,

A handwritten signature in dark ink, appearing to read "A. Towne", with a long, sweeping horizontal line extending to the right.

OCT 1 1992

"Document Control"

TYPE: ACTION

DOCUMENT NUMBER: 9202846

ORIGINATOR: 02

STATUS I

DIRECTORATE STATUS

FROM: TAYLOR, William D.: U.S. NAVY (RETIRED)

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 09/09/92

SUBJECT: HE IS WRITING TO EXPRESS HIS CONCERN OVER THE
ALLOCATION OF FUNDING FOR SCIENCE AND ASKS IF THERE
IS ANY WAY FOR HIS COMMENTS TO BE FORWARDED TO THE
PRESIDENT.

DIRECTORATE
ASSIGNED: PHYSICAL SCIENCES
STAFF
ASSIGNED:

ACTION
REQUIRED: DARFT FOR DAB
STAFF
ACTION:

OSTP DUE DATE:
DATE COMPLETED:
SENDER'S DUE DATE:
10/06/92
STAFF DUE DATE
DATE COMPLETED/DEPT: 11/20/92

COPIES TO: D. Allan Bromley

WHITE HOUSE TRACKING #:
REMARKS: REASSIGNED TO PHYSICAL SCIENCES PER DR. BROMLEY.
CONTACT PERSON:
PHONE:
EXT:

OSTP RECEIVED: 09/22/92
FILE: P-PHYSICAL SCIENCES
CENTRAL FILES:

DEPT RECEIVED:





TYPE: ACTION
ORIGINATOR: 02

"Document Control"

DOCUMENT NUMBER: 9202846
DIRECTORATE STATUS

STATUS I

FROM: TAYLOR, William D.: U.S. NAVY (RETIRED)

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 09/09/92

SUBJECT: HE IS WRITING TO EXPRESS HIS CONCERN OVER THE
ALLOCATION OF FUNDING FOR SCIENCE AND ASKS IF THERE
IS ANY WAY FOR HIS COMMENTS TO BE FORWARDED TO THE
PRESIDENT.

DIRECTORATE
ASSIGNED: DIRECTOR'S OFFICE

STAFF
ASSIGNED:

*Walt Exb.
Want to draft for me!
reply soon*

ACTION
REQUIRED: AS APPROPRIATE

STAFF
ACTION:

SENDER'S DUE DATE:
STP DUE DATE: 10/06/92
DATE COMPLETED: STAFF DUE DATE
DATE COMPLETED/DEPT:

COPIES TO: D. Allan Bromley
PHYSICAL SCIENCES

WHITE HOUSE TRACKING #:

CONTACT PERSON:
PHONE:

EXT:

REMARKS:

STP RECEIVED: 09/22/92
FILE: P-PHYSICAL SCIENCES

DEPT RECEIVED:

CENTRAL FILES:



THE WHITE HOUSE
WASHINGTON

November 20, 1992

Dear Captain Taylor:

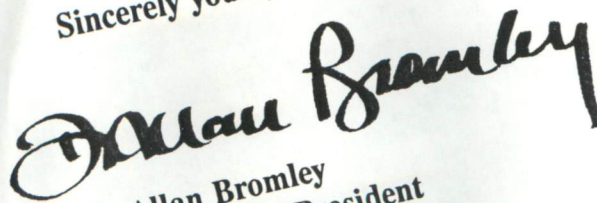
Thank you for your letter suggesting challenges or goals that could serve as spurs to economic growth.

We in the Bush Administration have attempted to address several of these through R&D initiatives which my Office has orchestrated in areas such as High Performance Computing, Biotechnology, Advanced Materials and Manufacturing Technology.

The mechanisms which my Office put in place to coordinate the technology programs of the various executive branch departments and agencies are working and, in my opinion, represent a major departure from the traditional way of doing business in Washington. It is my sincere hope that comparable coordination can be achieved in the future among the various Congressional committees that provide appropriations for these technology programs. Without that, additional progress will prove difficult.

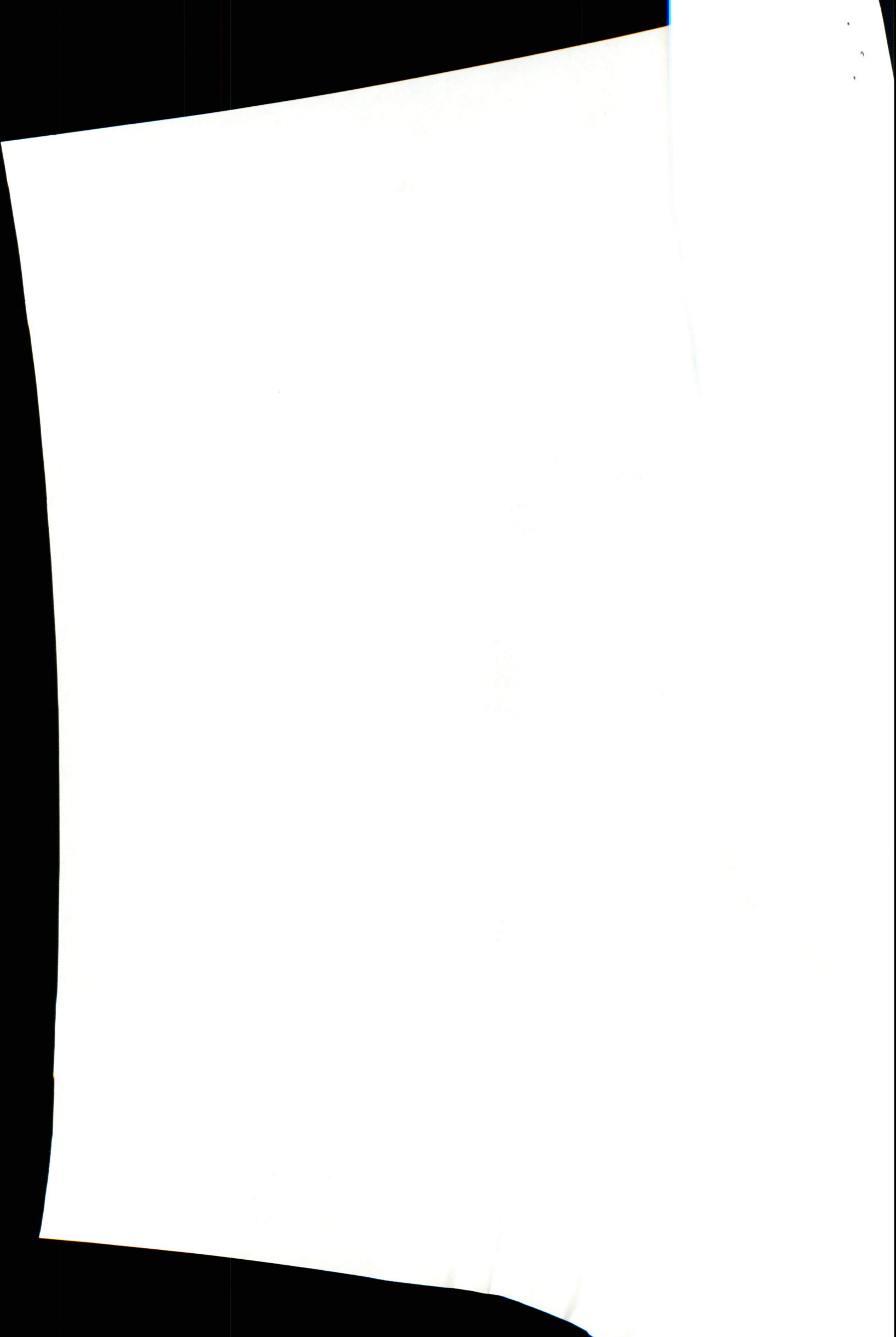
Thank you again for your comments.

Sincerely yours,



D. Allan Bromley
The Assistant to the President
for
Science and Technology

Capt. W.D. Taylor, USN (Retired)
2506 Lakevale Drive
Vienna, VA 22181



"Document Control"

TYPE: INFORMATION

DOCUMENT NUMBER: 9202893

ORIGINATOR: 02

STATUS C

DIRECTORATE STATUS

FROM: TOWNE, Andrew J.

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 09/11/92

SUBJECT: HE IS WRITING TO EXPRESS HIS VIEWS ON THE NATIONAL
AEROSPACE PLANE.

DIRECTORATE
ASSIGNED:

STAFF
ASSIGNED:

ACTION
REQUIRED:

STAFF
ACTION:

SENDER'S DUE DATE:

OSTP DUE DATE:
DATE COMPLETED:

STAFF DUE DATE
DATE COMPLETED/DEPT:

COPIES TO: D. Allan Bromley
PHYSICAL SCIENCES
Michelle Van Cleave

WHITE HOUSE TRACKING #:

CONTACT PERSON:
PHONE:

EXT:

REMARKS:

OSTP RECEIVED: 09/25/92
FILE: P-PHYSICAL SCIENCES

DEPT RECEIVED:

CENTRAL FILES:

THE WHITE HOUSE
WASHINGTON

November 20, 1992

Dear Captain Taylor:

Thank you for your letter suggesting challenges or goals that could serve as spurs to economic growth.

We in the Bush Administration have attempted to address several of these through R&D initiatives which my Office has orchestrated in areas such as High Performance Computing, Biotechnology, Advanced Materials and Manufacturing Technology.

The mechanisms which my Office put in place to coordinate the technology programs of the various executive branch departments and agencies are working and, in my opinion, represent a major departure from the traditional way of doing business in Washington. It is my sincere hope that comparable coordination can be achieved in the future among the various Congressional committees that provide appropriations for these technology programs. Without that, additional progress will prove difficult.

Thank you again for your comments.

Sincerely yours,

A handwritten signature in dark ink, reading "D. Allan Bromley". The signature is fluid and cursive, with the first name "D." being small and the last name "Bromley" being larger and more prominent.

D. Allan Bromley
The Assistant to the President
for
Science and Technology

Capt. W.D. Taylor, USN (Retired)
2506 Lakevale Drive
Vienna, VA 22181

Andrew J. Towne
17 Penrose Blvd.
Colorado Springs, CO 80906

11 September 1992

Mr. D. Allan Bromley
Assistant for Science and Technology to the President
1600 Pennsylvania Ave., NW
Washington, D C 20500

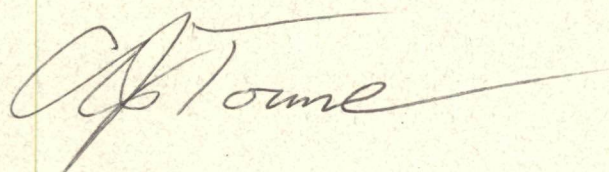
Dear Mr. Bromley;

Once in a generation an airplane comes along that changes everything. The hypersonic, Mach 18 X-30 National AeroSpace Plane is teaching us how to fly to orbit at \$1.00 a pound. Its technology will, after 2010, make flying to space like flying to Chicago.

Still, the House and Senate may kill this project that gives us the surest path to the spiritual and material bonanza of contact with the highest frontier, the next new world. The Senate Armed Services Committee has voted to say we can't afford this establishment of our grandchildren's prosperity. The X-30 National AeroSpace Plane gives a greater return on taxpayer's investment than any other use of the national seed-corn. Apollo did the same thing.

There is a still secret flight project to use a slower Mach 6 airplane to launch a small rocket carrying small payloads. The price improvement for this rocket versus ground-launched rockets is so great at Mach 6 that the social, practical and economic good of making one leap to space in a Mach 18 transport is being lost on some. Comparing the payload cost of a new dorsal missile to the untransport X-30 or transport progeny is like comparing the range economics across the Atlantic of the Short-Mayo Composite, used experimentally by Imperial Airways in 1938, with the DC-3, which had no payload at that kind of range, or the later DC-4.

Sincerely Yours,



OCT 1 1992

"Document Control"

TYPE: ACTION DOCUMENT NUMBER: 9202846
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

FROM: TAYLOR, William D.: U.S. NAVY (RETIRED)

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 09/09/92

SUBJECT: HE IS WRITING TO EXPRESS HIS CONCERN OVER THE
ALLOCATION OF FUNDING FOR SCIENCE AND ASKS IF THERE
IS ANY WAY FOR HIS COMMENTS TO BE FORWARDED TO THE
PRESIDENT.

DIRECTORATE STAFF
ASSIGNED: PHYSICAL SCIENCES ASSIGNED:

ACTION STAFF
REQUIRED: DARFT FOR DAB ACTION:

SENDER'S DUE DATE:
OSTP DUE DATE: 10/06/92 STAFF DUE DATE
DATE COMPLETED: DATE COMPLETED/DEPT: 11/20/92

COPIES TO: D. Allan Bromley

WHITE HOUSE TRACKING #: CONTACT PERSON:
PHONE: EXT:
REMARKS: REASSIGNED TO PHYSICAL SCIENCES PER DR. BROMLEY.

Sub drafted response.

OSTP RECEIVED: 09/22/92 DEPT RECEIVED:
FILE: P-PHYSICAL SCIENCES
CENTRAL FILES:



"Document Control"

TYPE: ACTION DOCUMENT NUMBER: 9202846
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

FROM: TAYLOR, William D.: U.S. NAVY (RETIRED)

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 09/09/92

SUBJECT: HE IS WRITING TO EXPRESS HIS CONCERN OVER THE
ALLOCATION OF FUNDING FOR SCIENCE AND ASKS IF THERE
IS ANY WAY FOR HIS COMMENTS TO BE FORWARDED TO THE
PRESIDENT.

DIRECTORATE STAFF
ASSIGNED: DIRECTOR'S OFFICE ASSIGNED:

ACTION
REQUIRED: AS APPROPRIATE STAFF
ACTION:

SENDER'S DUE DATE:
OSTP DUE DATE: 10/06/92 STAFF DUE DATE
DATE COMPLETED: DATE COMPLETED/DEPT:

COPIES TO: D. Allan Bromley
PHYSICAL SCIENCES

WHITE HOUSE TRACKING #: CONTACT PERSON:
REMARKS: PHONE: EXT:

OSTP RECEIVED: 09/22/92 DEPT RECEIVED:
FILE: P-PHYSICAL SCIENCES

CENTRAL FILES:

2846

Capt. W. D. Taylor USN (Ret) Ph.D.
2506 Lakevale Dr. Vienna, VA 22181

9 Sep 92

Dr. Allan Bromley
Executive Office Bldg.
The White House
Washington D.C

Dear Dr. Bromley:

I am appalled by the seemingly total lack of understanding of the causes of the current economic recession by either national political party. After fifty years of wartime economies that spurred industrial growth and consumer consumption, the "Peace Dividend" creates a vast vacuum into which a good deal of trash concepts are falling. To achieve a real recovery there must be a better sense of direction. Objectives supported by the Federal Government toward which industries can plan and commit retooling with a sense of confidence that they will be supported, are needed desperately. The projected dumping of upwards of two million skilled and able personnel into the job market this decade from the Armed Forces and Defense Industries is a resource of unlimited potential if properly directed.

As an experienced implementer of advanced technologies to operational objectives, I can see potential solutions in at least fifteen areas that could support the recovery. These include:

Aquaculture, communication infrastructure, real education/skills, energy, health, highway/bridge infrastructure, housing, international trade, mass transportation, ocean floor mining, railways, space mining and waste management.

I wrote the enclosed in an attempt to surface some of these challenges. Is there any hope of getting the President to take a serious look?

Sincerely,



William D. Taylor

P.S. George Will had two good articles in this morning's Post with reasons for not voting for either candidate. It's long past time our leaders(?) came up with some constructive programming. Retraining for what? Retooling for what?

✓

Capt. W. D. Taylor USN (Ret) Ph.D.
2506 Lakevale Dr.
Vienna, VA 22181

5 June 1992

Mr. Ross Perot
P.O. Box 577010
Dallas, TX 75251-7010

Dear Mr. Perot:

Your probable independent candidacy for President this year is a long overdue challenge to the political parties whose real objectives have never been the good of the country but self preservation and support of special interest groups. As a voter for over fifty years, I have had the objective of living long enough to vote for a candidate of choice rather than vote for the least objectionable. Maybe this year.

As an independent I consider the liberal left and conservative far right as equal threats to the welfare of the national and the world economies. No U.S. President is going to solve the myriad problems of this country, let alone the UNs, but I should at least like to see a candidate who recognizes the root cause of the recession and has some constructive ideas to improve the situation.

Having written several letters to Senators and party leaders without any indication of their acknowledgement or understanding, I will try the independent route to stimulating some action. If you can scare the hell out of the party incumbents and leadership(?) you will have achieved a worthwhile goal even if you don't run or win. There are indications that the White House is scared, if not panicked, but no indication that they understand or care about the major issues.

To me the situation seems simple overall, however, complex in execution. The U.S. and much of the world has been on a wartime economy since 1960. Collapse of the USSR and most communist governments so obviously reduced the requirement for acquisition of military capabilities for world wars that everyone wants a big share of the peace dividend. As many have observed, the dividend is peace and a three trillion dollar US debt, not a bank full of funds to pass out for welfare programs.

Our affluence of the 80s was created by the jobs generated to run the arms race which was fueled by credit. When Churchill initiated world wide fear of Russia, aided considerably by the philosophy of Lenin as executed by Stalin, the politicians on both sides could point to the outside threat to enslave/tax and incite their constituents. The formula worked to empower and corrupt officials on both sides of the "curtain."

With a daughter living in Exeter, I witnessed the start of the current recession in New Hampshire when Pease AFB was shut down. The very affluent and growing local economy was suddenly stripped of the military and civilian jobs that had supported the structure of housing, banking and community functions. The collapse put the State of NH

Mr. Ross Perot
5 June 1992
Page 2

in a depression that was not recognize by Bush as he was given the red carpet treatment by the Air Guard when passing through on his way to play in Kennebuckport.

The succeeding deep cuts, executed and proposed, in Defense forces and acquisitions not only eliminate jobs and trim excesses in over staffed industries but add close to one million skilled military personnel to the ranks of job seekers.

The Nation, and the World, needs a challenge to fill the vacuum. There are at least fifteen areas of endeavor that need challenging leadership from the President. Any one of these could provide major leverage to a recovery. Listed alphabetically:

1. Aquaculture (deep ocean as well as coastal farms)
2. Communication/Information Processing/Networking Infrastructures
3. Education/Marketable Skill Training (Not Degrees)
4. Energy
5. Environmentally Responsible Development/Environmental Reformation
6. Health
7. Highway/bridge Infrastructure
8. Housing (Project Habitat is very good)
9. International Trade
10. Maritime Industry
11. Mass Transportation
12. Ocean Floor Mining
13. Railways
14. Space, including near earth orbit mining of asteroids
15. Waste Management

We have had some talk but little leadership or policy on a few of these. "Let the market place work it out" won't do it. Many areas are interrelated. Some regulation and some funding will be required, but not bureaucracies that suck up the funding with little pass through to the action/production forces.

Education is a major screwup. We must erase the social stigma of a blue collar career. Master craftsmen deserve at least as much recognition as Ph.Ds.

Over twenty years without an energy policy is disgraceful.

As you are well aware, the computer software industry has great unrealized potential but most software companies are incompetent. They fail to understand their customers objectives.

Mr. Ross Perot
5 June 1992
Page 3

The President is in the right ballpark on trade but fails to recognize that it is primarily conducted with foreign carriers, resulting in near total loss of our once dominant maritime industry.

Too much emphasis on expensive junk for the military; BBs, SSNs, B2s, M1A1s, etc. has left us with forces barely adequate to cover the many potential contingency areas. Deep cuts will further reduce flexibility and readiness. Building 3 SSN 21s and 20 B2s will placate a few voters temporarily but we need a continuing production line of affordable units with reduced manning requirements that can cover more contingency bases. The fact that the majority of Allied casualties in Desert Storm were due to "friendly" fire is a disgrace. We have had the technology for over twenty years to solve the problem but "that's not the way we do it" attitudes have impeded implementation.

Paul Tsongas has been the only candidate honest enough to tell the voters they will have to help pay for recovery and the parties killed him.

Capitol gains taxes should be graduated, zero to 25K/yr then gradually raised to hit the big boys unless reinvested in job creating endeavors. Capitol gains is about the only way for poor people to get to middle class. I know from experience.

If you can initiate action in any of these areas you should have the upper hand in any debate. Give em hell!

Sincerely,

A handwritten signature in cursive script, appearing to read "Bill Taylor", with a long horizontal flourish extending to the right.

William D. Taylor

"Document Control"

TYPE: INFORMATION

DOCUMENT NUMBER: 9202864

ORIGINATOR: 02

STATUS C

DIRECTORATE STATUS

FROM: SATPATHY, L.: INSTITUTE OF PHYSICS

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 09/09/92

SUBJECT: HE IS FORWARDING A COPY OF THE REVIEW ARTICLE WHICH
RECENTLY APPEARED IN "PROGRESS IN PARTICLE AND
NUCLEAR PHYSICS".

DIRECTORATE
ASSIGNED:

STAFF
ASSIGNED:

ACTION
REQUIRED:

STAFF
ACTION:

SENDER'S DUE DATE:

OSTP DUE DATE:
DATE COMPLETED:

STAFF DUE DATE
DATE COMPLETED/DEPT:

COPIES TO: D. Allan Bromley
PHYSICAL SCIENCES

WHITE HOUSE TRACKING #:

CONTACT PERSON:
PHONE:

EXT:

REMARKS: ENCLOSURES TO DR. BROMLEY

OSTP RECEIVED: 09/25/92
FILE: P-PHYSICAL SCIENCES

DEPT RECEIVED:

CENTRAL FILES:



INSTITUTE OF PHYSICS

SACHIVALAYA MARG
BHUBANESWAR-751 005
INDIA

2864
Tele : 50790, 53919
Cable : R H Y S I C I S T
Telex : 0675-386 IOPIN
Fax : 0674-56142

Prof.L.Satpathy

September 9, 1992

Prof.D.Allan Bromley,
Assistant to the President
for Science and Technology,
The White House,
Washington.

Dear Prof.Bromley,

I take this opportunity to express my gratitude for your encouraging and appreciative letter of June 14, 1990, on our work on 'Nuclear Molecular Resonances'. In the meantime we have applied our model to four other systems like $^{12}\text{C} + ^{16}\text{O}$, $^{16}\text{O} + ^{16}\text{O}$, $\alpha + ^{12}\text{C}$ and $\alpha + ^{16}\text{O}$, where we are able to account almost all the states observed in experiment. It is interesting to find that in $^{12}\text{C} + ^{16}\text{O}$, $^{16}\text{O} + ^{16}\text{O}$ systems, the rotational vibrational characteristics are much better pronounced compared to that in the $^{12}\text{C} + ^{12}\text{C}$ system.

In our study we obtain the depths of the potentials in the $^{12}\text{C} + ^{16}\text{O}$, and $^{16}\text{O} + ^{16}\text{O}$ systems to be 16.27 and 22.8 MeV respectively. This is indicative of the importance of the well-known O^+ state at 16.75 MeV in ^{16}O -nucleus which is a linear chain of four alpha-cluster. Therefore, it is reasonable to suppose that this state might be playing an important role in the mechanism of the quasi-molecular states in these two systems.

I hope you have seen the paper entitled, "Evidence for alpha-particle chain configurations in ^{24}Mg ", by Betts et. al., Phys. Rev. Lett. 68 (1992) 1295, which appeared on 2nd March. They clearly see in the $^{12}\text{C} + ^{12}\text{C}$ inelastic scattering, the emerging two ^{12}C -nuclei are in the excited O_2^+ state at 7.65 MeV. This state occurs at 32.5 MeV and has angular momentum 14^+ . This experimental result clearly supports the mechanism of NMR envisaged in our model.

I have enclosed a reprint of the review article which has just appeared in "Progress in Particle and Nuclear Physics".

With best regards,

Yours sincerely,

L. Satpathy
(L.Satpathy)

Reprinted from

*PROGRESS IN PARTICLE AND
NUCLEAR PHYSICS*

Vol. 29, pp. 327-452

NUCLEAR MOLECULAR RESONANCES

L. SATPATHY

Institute of Physics, Bhubaneswar, 751 001, India

PERGAMON PRESS LTD

OXFORD · NEW YORK · SEOUL · TOKYO

1992

"Document Control"

TYPE: INFORMATION

DOCUMENT NUMBER: 9202701

ORIGINATOR: 02

STATUS C

DIRECTORATE STATUS

FROM: ST. PETER, ED

TO: PRESIDENT BUSH

DATE OF
CORRESPONDENCE: 09/04/92

SUBJECT: HIS THEORY OF MAGNETIC MOLECULAR SHAPING (MMS) FOR
THE PURPOSE OF DEVELOPING AND PRODUCING A MATERIAL
CAPABLE OF SUPERCOMPUTING PROPERTIES AT LIFE
SUPPORTING TEMPERATURES.

DIRECTORATE
ASSIGNED:

STAFF
ASSIGNED:

ACTION
REQUIRED:

STAFF
ACTION:

SENDER'S DUE DATE:

OSTP DUE DATE:
DATE COMPLETED:

STAFF DUE DATE
DATE COMPLETED/DEPT:

COPIES TO: PHYSICAL SCIENCES
INDUSTRIAL

WHITE HOUSE TRACKING #:

CONTACT PERSON:
PHONE:

EXT:

REMARKS:

OSTP RECEIVED: 09/08/92 DEPT RECEIVED:
FILE: P-PHYSCIAL SCIENCES-SUPERCOMPUTING

CENTRAL FILES:

Ed St. Peter
R2 Box 647
Orrington, Me 04474
(207)-825-4086

George Bush
President of the United States of America
c/o Science Advisory Committee
The White House
Washington, D.C.

Dear Mr. President,

Please allow me to introduce myself, I am an electrical engineering student at the University of Maine in Orono. I am writing this letter to you because I believe you have the same love and respect for life that I do, also I fear that if you are not re-elected the leadership of this country will fall into the wrong hands.

Its appears to me that if you could restore the faith in the citizens of this country that you have the ability to rebuild the economy then your chances for another term would be greatly increased. From history I have learned that from the dawn of man's civilization, there has always been an idea to inspire man & woman to persue a better life for themselves, their families and their countries.

Ever since Columbus made his vogages to the new world, America has been the idea of hope and inspiration for uncounted millions of people in the rest of the world. They believe a place for freedom, democracy and economic prosperity truly does exist in America. For some God given reason I believe an idea has been bestowed upon me that will spawn a new technology that will benifit the people of America and the citizens of the world. Mankind is at the point in time to realize the struggle between oneself and neighbor is coming to an end. A great challenge is before us all. It is the necessity to control the elements in a more beneficial fashion so that human beings can endure into the future and very possibly take her seed to other worlds.

I must share this idea with someone or my life will be in vain. I have developed a theory of magnetic molecular shaping (MMS) of which the sole purpose is to develop and produce a material capable of superconducting properties at life supporting temperatures. I believe there are facilities in this country to test this theory. Most likely at the research labs of Bell Telephone and IBM. The theory rest on the fact that certain organic dipole polymers can be forced into proper alignment when relatively small magnetic fields are applied. When the molecules reach critical alignment, a state of terminal orbital resistance exist. The total matrix then acts as one magnetic domain. The end result an induced superconducting condition.

If this theory proves to be true and if you think that this idea may help you in your re-election campaign to show to the American people that you have the solutions to the economic dilemma then feel free to tell the public that a new technolgy is borne to help make life safer & easier for everybody.

Nature always provides obstacles but when people work together any obstacles can be overcome. If you need a dynamic person to speak to the voters during your re-election campaign to discuss and explain the possibilities of this subject, I will be more than glad to offer my services.

You may find it necessary to find out who I am. So to make life easier, my sister is Fran Weston, former state representative of Pa., republican ward leader in Phila. and good friend of Dick Thornberg. She had the honor of having lunch with your lovely and charming wife at the White House a few years ago. I was told you were scheduled to be there but the Panama crisis was happening which kept you from attending.

Best of luck in the campaign, may God be with you & your family and grant you the wisdom & knowledge for the next 4 years. Let the best man win.

yours truly,

Ed St. Peter *

Ed St. Peter

"Document Control"

TYPE: ACTION DOCUMENT NUMBER: 9202840
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

FROM: KENNEDY, Art

TO: DR. D.A. BROMLEY

SEP 24 1992

DATE OF
CORRESPONDENCE: 09/03/92

SUBJECT: HE IS FORWARDING A COPY OF HIS PROPOSAL REGARDING
THE ELECTRICAL NATURE OF THE UNIVERSE.

DIRECTORATE STAFF
ASSIGNED: PHYSICAL SCIENCES ASSIGNED: Lee Schroeder

ACTION
REQUIRED: AS NECESSARY or symm. to STAFF
ACTION:

SENDER'S DUE DATE:
OSTP DUE DATE: 10/06/92 STAFF DUE DATE
DATE COMPLETED: DATE COMPLETED/DEPT: 11/24/92

COPIES TO: D. Allan Bromley

WHITE HOUSE TRACKING #: CONTACT PERSON: ✓
PHONE: EXT:
REMARKS: PLEASE NOTE: DR. SCHROEDER ATTEMPTED TO REPLY TO AN EARLIER
LETTER FROM MR. KENNEDY, BUT DID NOT HAVE THE RETURN ADDRESS.

Dr. Schroeder responded.

OSTP RECEIVED: 09/22/92
FILE: P-PHYSICAL SCIENCES

DEPT RECEIVED:

CENTRAL FILES:



2540

Sept. 3, 92

Mr. D. Allan Bromley,

I'm amazed at the broad scope of your key roles in science and technology, in addition to being science advisor to President George Bush.

In the past 12 months I've sent letters to the heads of a few government agencies, communicating my views on the electrical nature of the universe.

When I didn't get replies, it didn't disappoint me much. I know big agencies like NASA, D.O.E, etc. must get hundreds of proposals. By not answering, they will soon find out how persistent and dedicated the proposers are. In this way, the proposals will tend to sort themselves out.

Also they figure if the proposal is good, then try getting it published, and run the gamut of your peers, etc. All of which, with your experience you know much more about than I do.

About 1987, I told my relatives and a few friends about my efforts in cosmology. I wish I had waited at least one more year - then I'd be ahead a year, instead of constantly trying to make schedule. You must run into that and more - so, I'm enclosing a copy of the information mailed out to government agencies and universities.

Sincerely,

Art Kennedy

1063 N. Williams

PALATINE IL 60067

This is not a final paper, but does contain most of the points that will be required in a final paper, hopefully finished in October, so please excuse the order of content and the attached work graph of the background.

Background- Six years in the U.S. Air Force 1940-46, the latter few years as a navigator in a B24 bomb group based in England. This stint followed by six years with the U. S. Weather Bureau Mobile, Ala. at Bates Field. Started out as a GSS weather observer, and passed a test to GC 7 and could then brief pilots. Then followed 25 years as a meteorologist for United Air Lines.

I became a member of AAAS about 1965 and enjoyed a strong interest in technology and physics, the latter mostly as it applied to neutrons, electrons and protons in the early stages of the B-Bang.

Apparently my interest was shaped by my experience as a navigator and the associated wonderment about the stars.

Title-- "The Cosmological Electrical Nature of the B-Bang"

There hasn't been a paper published about the electrical nature of the universe, however two or three scientists in the past ventured the universe was probably or possibly electrical in nature, but acknowledged they could offer no specifics.

About 1967, my studies determined the universe and everything in it was basically electrical, since everything was composed of 0.5% negative and 0.5% positive monopoles.

Not having been educated in college math or science, it took another nine years, or 27 years since retirement, of intensive study to arrive at any evidence of such a conclusion.

In regard to monopoles, originally scientists figured monopoles would be 10²⁸ and the neutron would have a rest mass of 1, 2 or 3, but after decades of fruitless search for magnetic monopoles, a few decided magnetic monopoles were massive. One paper ventured a mass equal to many, many protons.

Over the years some great work has been accomplished by physicists using the electromagnetic spectrum. It certainly appeared obvious that electric and magnetic monopoles in equal numbers accounted for the photon. We would never consider any other possible explanation of the electromagnetic spectrum. It certainly appeared obvious electric and magnetic monopoles, in equal numbers accounted for the photon.

Therefore the thought of such a massive magnetic monopole was disturbing - that massive a particle should likely have been discovered many years ago.

luckily, the thought struck, what if magnetic monopoles did not exist? The answer was obvious, would that be electrical and the photon would account for the magnetic as well as electrical phenomena, and I fully appreciate the need for a 6 particle as well.

A few hours later, I had had a flash where I saw flashes representing negative and positive monopoles, that would form the nucleus of ^1_0e and the ^1_0e ^1_0e dimensional charged negative or positive tetrahedron at 4.5v, and would identify the central tetrahedron at 6v, the crown tetrahedron at 13.5v etc.

Buckminster Fuller in his great 'Synergetics' - states that the above three are the fundamental geometric forms of the universe, and finds the tetrahedron to be the prime structural system of the universe. If we add the spherical neutrino these then will evolve into other geometrical forms and result in the universe.

Batteries: It is well known the carbon zinc primary cell battery provides direct current and a basic voltage of 1.5v, and by adding more cells in series, produces batteries of 3v, 4.5v, 6v, 9v, etc. All are evenly divided by 1.5v or 4.5v. This is another indicator the electrical monopole theory is viable.

As has been pointed out by Fuller and others, it is apparent the our present laws of mathematics and physics, and in fact any mathematics were utilized in the B-2's grand old unfolding plan. The very essence of mathematics, geometry, algebra, trigonometry, computer, and the like, are the laws of the universe in action.

The computer - the great modern computer - it was based on the binomial method, using 0's and 1's. The computer is based on the binomial 1 and 0. Using the 1 as a positive or negative value and the 0 as a neutral value, the computer is electrical in nature. Each circuit controls one of the equivalent of the 0's, 1's, and 0's. The computer is the equivalent of the binomial method.

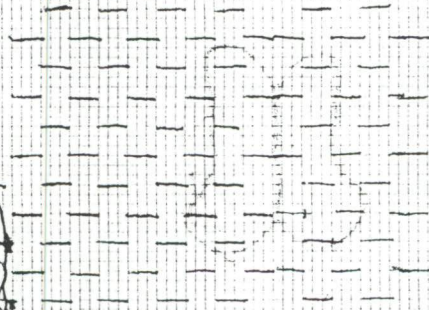
It is known that with an infinite of time and space, there would be no end of infinity. I believe the center of the universe would have to be where vast fields of positive monopoles moving outward would first make contact with vast fields of negative monopoles moving inward.

The muon should prove to be the center of the universe and neutron. The particle accelerator research has truly great work. It has shown a neutron or a proton decays into a muon or a pion, except once in every thousand times. This appears to indicate the muon is the B-2's would likely develop as the inner nucleus with a shell of six mesons clustering around the muon.

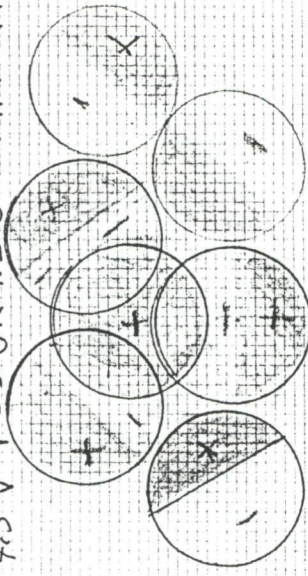
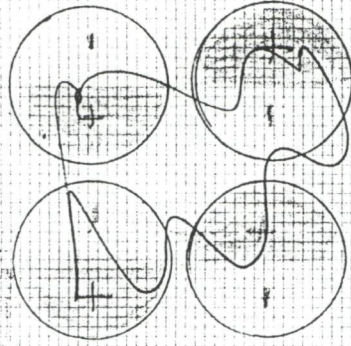
The universe was the first to understand a sphere will contain the most volume for the least surface area when compared to any



2B



The First 4Pos and 4 NEG MONOPOLES
WOULD PRODUCE THE TETRAHEDRON AT SAME INSTANT
ONE MONOPOLE, EITHER POS OR NEG COULD JOIN ~~ONE~~ OF
THE 4 VERTECES AND INSURE THE CHARGED TETRAHEDRON
4.5V POS OR NEG WHICH



~~AND~~ WOULD LATER INSURE
OTHER CHARGED PARTICLES.

With neutrinos easily assembled, the universal computer knew it
had to create the tetrahedron. As Buckminster Fuller noted: The tetrahedron was
strongest of the three primary geometrical forms. It would be, made stronger
when becoming and dominating the charged tetrahedron, which would be needed
by the many millions in creating just one proton.

It appears we are in the Northern hemisphere of the universe. We have won-
dered about the dearth of anti-particles, of matter-antimatter. The proton
as theorists figured would be negative and a positron would orbit the
anti-proton.

There is a ~~good~~ possibility this did occur in the Bang - a matter
and anti-matter universe born simultaneously "and next the twin
shall meet."

"Document Control"

TYPE: ACTION DOCUMENT NUMBER: 9202840
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

FROM: KENNEDY, Art

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 09/03/92

SUBJECT: HE IS FORWARDING A COPY OF HIS PROPOSAL REGARDING
THE ELECTRICAL NATURE OF THE UNIVERSE.

DIRECTORATE STAFF
ASSIGNED: PHYSICAL SCIENCES ASSIGNED:

ACTION STAFF
REQUIRED: AS NECESSARY ACTION:

SENDER'S DUE DATE:
OSTP DUE DATE: 10/06/92 STAFF DUE DATE
DATE COMPLETED: DATE COMPLETED/DEPT:

COPIES TO: D. Allan Bromley

WHITE HOUSE TRACKING #: CONTACT PERSON:
PHONE: EXT:
REMARKS: PLEASE NOTE: DR. SCHROEDER ATTEMPTED TO REPLY TO AN EARLIER
LETTER FROM MR. KENNEDY, BUT DID NOT HAVE THE RETURN ADDRESS.

OSTP RECEIVED: 09/22/92 DEPT RECEIVED:
FILE: P-PHYSICAL SCIENCES

CENTRAL FILES:

2840

Sept. 3, 92

Mr. D. Allan Bromley,

I'm amazed at the broad scope of your key roles in science and technology, in addition to being science advisor to President George Bush.

In the past 12 months I've sent letters to the heads of a few government agencies, communicating my views on the electrical nature of the universe.

When I didn't get replies, it didn't disappoint me much. I know big agencies like NASA, D.O.E, etc. must get hundreds of proposals.

By not answering, they will soon find out how persistent and dedicated the proposers are. In this way, the proposals will tend to sort themselves out.

Also they figure if the proposal is good, then try getting it published, and run the gamut of your peers, etc. All of which, with your experience you know much more about than I do.

About 1987, I told my relatives and a few friends about my efforts in cosmology. I wish I had waited at least one more year - then I'd be ahead a year, instead of constantly trying to make schedule. You must run into that and more-so, I'm enclosing a copy of the information mailed out to government agencies and universities.

Sincerely,
Art Kennedy

1063 N. Williams

Palatine IL 60067

1

This is not a final paper, but does contain most of the points that will be included in a final paper, hopefully finished in October, so please excuse the order of content and the attached work graph of the tetrahedron .

Background- Six years in the U.S. Air Force 1940-46, the latter few years as a navigator in a B24 bomb group based in England. This stint followed by six years with the U. S. Weather Bureau Mobile, Ala. at Bates Field. Started out as a GS5 weather observer, and passed a test to GS 7 and could then brief pilots. Then followed 25 years as a meteorologist for United Air Lines.

I became a member of AAAS about 1965 and enjoyed a strong interest in cosmology and physics, the latter mostly as it applied to photons, electrons and protons in the early stages of the B-Bang.

Apparently my interest was shaped by my experience as a navigator and the associated wonderment about the stars.

Title-- " The Cosmological Electrical Nature of the B- Bang"

There hasn't been a paper published about the electrical nature of the universe . However two or three scientists in the past ventured the universe was probably or possibly electrical in nature , but acknowledged they could offer no specifics.

About 1987, my studies determined the universe and everything in it was basically electrical, since everything was composed of 0.5v negative and 0.5 positive monopoles.

Not having been educated in college math or science, it took another five years , or 12 years since retirement , of intensive study to offer any evidence of such a contention.

In regard to monopoles , originally scientists figured monopoles would be tiny, and the neutrino would have a rest mass of 1, 2 or 3v, but after decades of fruitless search for magnetic monopoles, a few decided magnetic monopoles were massive. One paper ventured a mass equal to many, many protons.

Over the years much great work has been accomplished by physicists using the electromagnetic spectrum. It certainly appeared obvious electric and magnetic monopoles in equal numbers accounted for the photon. We would never consider any other possible explanation of the electromagnetic spectrum. It certainly appeared obvious electric and magnetic monopoles, in equal numbers accounted for the photon.

Therefore the thought of such a massive magnetic monopole was disturbing - that massive a particle should likely have been discovered many years ago.

2

Luckily, the thought struck. What if magnetic monopoles did not exist? The photonic e/m waves would then be electrical and the photon would account for the magnetic as well as electrical phenomena, and likely obviate the need for a G particle as well.

A few hours using red and black pens showed tiny dashes representing negative and positive monopoles, that would form the neutrino at 1v and the first three dimensional charged negative or positive tetrahedron at 4.5v, and would identify the neutral octahedron at 6v, the icosahedron at 13.5v. etc.

Buckminster Fuller in his great 'Synergetics' - states that the above three are the fundamental geometric forms of the universe, and finds the tetrahedron to be the prime structural system of the universe. If we add the spherical neutrino these then will evolve into other geometrical forms and result in the universe.

Batteries: It is well known the carbon zinc primary cell battery provides direct current and a basic voltage of 1.5v, and by adding more cells in series, produces batteries of 3v, 4.5v, 6v, 9v, etc.. All are evenly divided by 1.5v or 4.5v. This is another indicator the electrical monopole theory is viable.

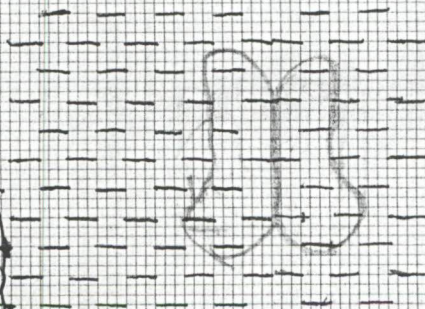
As has been pointed out by Fuller and others, it is apparent the now proven laws of mathematics and physics, and in fact any discipline were utilized in the B-Bang's grand still unfolding plan. Man was capable of inventing the automobile, airplane, computers, rockets etc. (only because the laws of the universe permitted.)

Take computers-- The great pre-Bang computer in the sky was based on the binomial method, using +0.5v and -0.5 monopoles. Man's computer is based on the binomial 1 and 0. Using the 1 as a positive or negative value and the 0 as is well known the automatic electrical switch to on or off. Each method totals one or the equivalent of two 0.5v monopoles, and can be programmed to accomodate the highest powers.

It is known that with and infinity of time and space, there would be no center of infinity. I believe the center of the universe would have to be where vast fields of positive monopoles moving southward would first make contact with vast fields of negative monopoles moving northward.

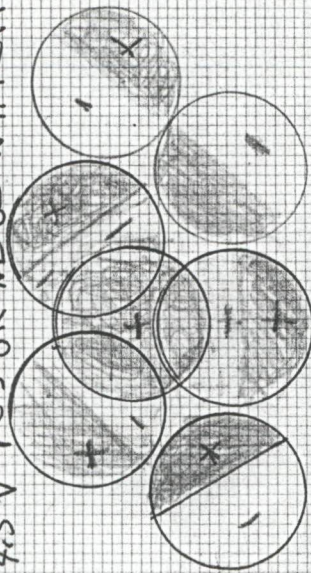
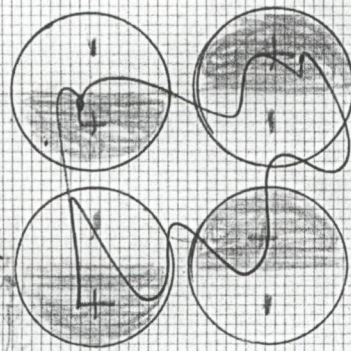
The muon should prove to be the center of the proton and neutron. The particle accelerator scientists truly great work proved a meson+ or - always decays into a muon + or -, except once in seven thousand times. This appears to indicate the muon in the B-Bang would likely develop as the inner nucleus with a shell of six mesons clustering around the muon.

The universe was the first to understand a sphere will contain the most volume for the least surface area when compared to any



2B

The First 4Pos and 4 Neg Monopoles
 would produce the tetrahedron at same instant
 one monopole, either pos or neg could join ~~any~~ of
 the 4 vertices and insure the charged tetrahedron
 4.5V pos or neg which



~~that~~ would insure
 other charged particles.

With neutrinos easily assembled, the universal computer knew it
 had to create the tetrahedron. As Buckminster Fuller noted: The tetrahedron was
 strongest of the three primary geometrical forms. It would be, made stronger
 when becoming and dominating the charged tetrahedron, which would be needed
 by the many millions in creating just one proton.

It appears we are in the Northern hemisphere of the universe. We have won-
 dered about the dearth of anti-matter, of matter-anti-matter. The proton
 as theorists figured would be negative and a positron would orbit the
 anti-proton.

There is a ~~good~~ possibility this did occur in the Bang - a matter
 and anti-matter universe born simultaneously "and never the twain
 shall meet."

other geometric form. This is apparent when we look at the moon, sun, and satellite images of planets.

From the large to the tiny-- scientists have displayed enlarged pictures of protons and electrons as perfect or near perfect spheres.

Lord Kelvin was the first to prove a sphere could be created by packing two hundred spheres in layers around 1 sphere. Buckminster Fuller's great book 'Synergetics' enlarged on the role of the tetrahedron, the octahedron and icosahedron. He knew these as the building blocks of matter.

Of course any proof the universe is electrical in nature will bring about changes in the course of cosmology, bio-chemistry, bio-electrical, bio-physics, etc. applications. These and other disciplines are tied together with a common heritage.

We wondered why there was a dearth of positrons. This can best be explained by figuring the charged nucleon is made up largely of electrons. My studies indicate there would be one more positron than the number of electrons making up the positively charged nucleon.

Of the octillions of protons in a chunk of matter, there are then an equal amount of free electrons.

We read where electrons and nucleons are constantly vibrating and or oscillating. Since there are many positive and negative electrons in a proton, and in fact account for more than 95 percent of its mass, we wonder what force prevents the electrons self-destruction. How many photons does a proton contain? Surely not a few but many. As yet there isn't any conceivable method of isolating one photon and measuring the mass.

Thinking one day about Lord Kelvin's sphere, and realizing the mass of a muon has been shown to be equivalent to the mass of 207 electrons. Then if the mass had been equal to 196 or 207 electrons, it would not serve as the center, since succeeding mesonic layers would not form a sphere.

The universal grand plan often dotes on spheres. it would not likely pass up a perfect sphere such as a muon composed of 201 spheres, which would insure that all additional layers of a close packed sphere would automatically lead to a spherical proton. The much greater lifetime of a muon compared to the mesons would provide sufficient time for the six mesons to join the muon.

If this is so-- then finally a clue to the photon. The six electron excess should then account for a photonic mass of 3065877ev or 2.8985507% of the muon mass. $3065877\text{ev} / 1.5 = 2043918$, $/4.5 = 681306$, $/13.5 = 227102$, $/27 = 113551$, $/40.5 = 75700.66667$ $0.666667 * 40.5 = 27$, $/54 = 56775.5$ $0.5 * 54 = 27\text{ev}$. etc.

The 201 electrons would account for 97.101449 % of the muon mass or $105772756.5 \text{ ev} / 13.5 \text{ ev} = 7835019$, etc..

We don't know how the electron was put together, however it is likely that $510979.5 / 1.5 = 340653$, $/ 4.5 = 113551$, $/ 13.5 = 37850.3333$

$0.33333 * 13.5 = 4.5$, $/ 27 = 18925.16667$ $0.16667 * 27 = 4.5$ etc..

and that the tetrahedron will be the major particle involved.

I have never studied it, but we read where electrostatic and gravitational forces are much alike because both forces are due to the similar electrical nature of both effects.

Many electricians have often wondered why 0.1111111 is the decimalization value that most often appears in their readings. The tetrahedron and its increments of 4.5ev and dual photonic waves help explain. Consider numbers 4, 4.5, 5. In dividing sequentially increase each dividend by 0.5ev and increase each divisor by the initial amount. $0.5 / 4 = 0.125$, $0.1 / 8 = 0.125$, $1.5 / 12 = 0.125$ etc.

$0.5 / 4.5 = 0.1111111$, $1.0 / 9 = 0.1111111$, $1.5 \text{ ev} / 13.5 = 0.1111111$

$0.5 / 5 = 0.100$ $1 / 10 = 0.1$ $1.5 / 15 = .10$ etc.

It appears the Quark theory is not the final answer, although physicists note it has advanced their knowledge of the mesons.

The neutral neutrino comprises well over 50% of the matter in the universe, and this fact should contribute much to the stability of leptons and hadrons.

I will appreciate your comments. Currently working on the electron-- this may prove to be a much tougher problem, since we don't have any knowledge about its makeup.

Art Kennedy
1063 North Williams Dr.
Palatine, Illinois 60067

Adressed to : Argonne National Laboratory
Argonne, Il., Brookhaven National Laboratory, N.Y., California
Institute of Technology Pasadena, Clemson University S.C.,
Department of Energy, Washington D.C., Fermi National
Accelerator Laboratory, Il., Illinois Institute of Technology.
Chicago, Massachusetts Institute of Technology, Cambridge,
National Aeronautics and Space Administration, Washington D.C.,
National Science Foundation, Washington D.C., Purdue University,
IN. University of Chicago Il.

9202813

ORIGINATOR: 02

STATUS I

DIRECTORATE STATUS

FROM: DAVIS, Jay C.: LAWRENCE LIVERMORE NATIONAL LABORATORY

TO: DR. D.A. BROMLEY

SEP 23 1992

DATE OF
CORRESPONDENCE: 09/03/92

SUBJECT: HE IS WRITING REGARDING THEIR CURRENT AMS STATUS AND
THE PROPOSED FOLLOW ON TO THEIR LAB AT UC IRVINE.

DIRECTORATE

STAFF

ASSIGNED: **PHYSICAL SCIENCES**

ASSIGNED:

ACTION
REQUIRED: **IF NECESSARY**

STAFF
ACTION:

SENDER'S DUE DATE:

OSTP DUE DATE: **09/30/92**

STAFF DUE DATE

DATE COMPLETED:

DATE COMPLETED/DEPT: **9/28/92**

COPIES TO: D. Allan Bromley

WHITE HOUSE TRACKING #:

CONTACT PERSON:

PHONE:

EXT:

REMARKS:

Dr. Etk responded.

OSTP RECEIVED: 09/21/92
FILE: P-PHYSICAL SCIENCES

DEPT RECEIVED:

CENTRAL FILES:



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

September 28, 1992

Dear Jay,

In response to the news about your AMS facility, Allan and I have only one comment: nice work!

I regret that I didn't have a chance on my recent whirlwind visit with the ICF folks at LLNL to see you. Maybe next time. Allan and I look forward to your comparable success at Irvine.

Best regards,



Karl A. Erb

Associate Director
for Physical Sciences and Engineering

cc: D.A. Bromley

Dr. Jay C. Davis
Director
Center for Accelerator Mass Spectrometry
Lawrence Livermore National Laboratory
P.O. Box 808
Livermore, CA 94550

2813



Lawrence Livermore National Laboratory

RECEIVED

September 3, 1992 92 SEP 21 A 9: 58

OSTP
MAIL ROOM

Professor Allan Bromley
Presidential Science Advisor
Executive Office of the President
Office of Science & Technology Policy
Old Executive Office Bldg., R-360
17th & Pennsylvania Avenue, NW
Washington, DC 20506

Dear Allan:

I thought I'd pass along to you two numbers that, in different ways, may startle and then amuse you. The first has to do with our current AMS status, the second with the proposed follow-on to our lab at UC Irvine.

When we started the AMS effort at Livermore, I promised that we could probably build a machine that would have the equivalent capacity of 5,000-10,000 samples per year, a factor of two or four improvement over most dedicated facilities. At the time, even my own crew gave me a little guff about that public statement. We now find that on the one day a week devoted to biomedical AMS measurements of ^{14}C , we are running at an equivalent rate of 50,000/samples per year. We do these measurements to 1% precision (and about that accuracy) primarily to give the experimenter a chance to think between sample changes occurring at 60 second intervals. When the new automated back is installed on the ion source, I expect to see another doubling of throughput. We have sustained this rate for several months with the experimental program of Vogel and Turteltaub, so it's no fluke. Such results obviously change the calculus of the business. We don't quite know where we will reveal this fact yet, as we're still digesting the implications, but I thought you'd enjoy knowing in advance.

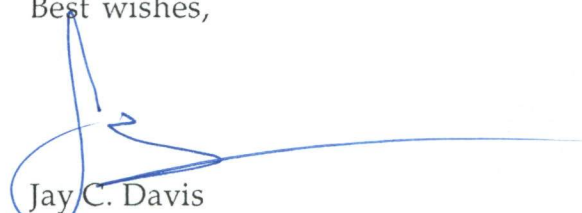
Discussions at Irvine about a geoscience clone of our facility, carried forward by Ralph Cicerone and Sherry Rowland, have reached the point that we've begun the cartoon design and single figure costing of the project. What will amuse you is the promise by the local grad dean to expel the particle physics group from 4000 square feet of heavy lab space to provide a home for the spectrometer. I know it's unseemly for a low energy nuclear physicist to gloat about the prospect of installing a 30-year old EN tandem in space belonging to the High Energy branch of the Church, but I figured that you could appreciate it better than anyone I know and grant forgiveness, if not absolution, for such thoughts. It's all the greater pleasure for me because I'll use the old Texas machine that Bernie Kinsey was installing

September 3, 1992
Page 2

when I was an undergraduate. I wasn't hired for one of the installation jobs back in '62, so it looks like both the machine and I will get a second chance. Plan on being a speaker at the dedication; I'll bend your arm for that favor.

Enjoyed the visit with you. If your schedule ever allows casual visits, come out and see what our lab looks like now. The past five years have made a big difference. We continue to find the multi-disciplinary aspects of this business rewarding. Yet another patent disclosure is in the works, this time on using PIXE and possibly XRF techniques to replace ^{32}P in postlabeling of DNA adducts.

Best wishes,



Jay C. Davis
Director
Center for Accelerator
Mass Spectrometry

JCD:nms

THE WHITE HOUSE
WASHINGTON

September 30, 1992

Dear Jay:

Many thanks for the information concerning your AMS program. You have been spectacularly successful as, in fact, I assumed you would but the rate at which you are putting samples through your system now is truly remarkable.

I indeed do derive perverse pleasure from the thought of moving out a particle physics group to make room for a lowly EN tandem. Beyond that I think Bernie Kinsey would be ecstatic because he had very little use for that particular branch of the Church. I don't know whether you have read his book or not but he manages to skewer just about every physicist that he has ever met with special attention being devoted to C. Fred Moore -- not without reason, of course.

I too enjoyed your visit here. Please do let me know when your plans bring you through Washington again and we will try to arrange lunch at the White House Mess. This fall, unfortunately, my schedule is very hectic as you can perhaps imagine and, although I would much like to get out to Livermore again, the probability of my doing it before the end of this calendar year is probably vanishingly small.

Again, congratulations on the AMS work and with warmest best wishes,

Sincerely yours,



D. Allan Bromley
The Assistant to the President
for
Science and Technology

Dr. Jay C. Davis
Lawrence Livermore National Laboratory
Post Office Box 808
Livermore, California 94550

TYPE: ACTION
ORIGINATOR: 02

DOCUMENT NUMBER: 9202685
DIRECTORATE STATUS

STATUS I

FROM: BARRETT, Bruce

TO: DR. D.A. BROMLEY

SEP 10 1992

DATE OF
CORRESPONDENCE: 09/02/92

SUBJECT: HE IS WRITING TO EXPRESS HIS CONCERN OVER THE
EXTREME THREAT POSED BY AGING NUCLEAR REACTORS IN
THE FORMER SOVIET UNION.

DIRECTORATE
ASSIGNED: PHYSICAL SCIENCES

STAFF
ASSIGNED: 9/12 Lee Schroeder
(Mention our purchase
+ use of funds for
reactor safety in
response)

ACTION
REQUIRED: DIRECT REPLY

STAFF
ACTION:

SENDER'S DUE DATE:

OSTP DUE DATE: 09/23/92

STAFF DUE DATE

DATE COMPLETED:

DATE COMPLETED/DEPT: 11/18/92

COPIES TO: D. Allan Bromley
INTERNATIONAL/POLICY

WHITE HOUSE TRACKING #:

CONTACT PERSON:

PHONE:

EXT:

REMARKS: Dr. Schroeder responded.



OSTP RECEIVED: 09/09/92 DEPT RECEIVED:
FILE: P-PHYSICAL SCIENCES-ENERGY

CENTRAL FILES:



7685

Bruce Barrett
1164 Emerald, # 1
Madison WI 53715

September 2, 1992

Dr. Allan Bromley
Old Executive Office Bldg.
Washington, DC 20500

Dear Dr. Bromley,

I am writing you today to express my concerns about the extreme threat posed by several aging nuclear reactors in the former Soviet Union. The human and environmental consequences should any of them fail are dire - death, sickness, and hunger on a scale similar to Chernobyl. Graphite-cooled and pressurized-water reactors are inherently unsafe. I do not believe that any means of rebuilding would be adequate to insure the safety of the millions of people living in reactor-endangered areas.

I do not have a detailed plan for supplying the energy needed for powering a modern society. Coal and hydroelectric have their own dangers. However, in my opinion it is imperative that unsafe reactors be shut down, as soon as possible. Support of energy conservation - insulation, public transport, bicycles -, and alternative energy - solar, wind, geothermal, tidal - is essential to any rational plan for the earth's future.

Please lend your support to 1) the closing of unsafe reactors in eastern Europe and the Asian republics, and 2) the development of safe, clean, renewable, locally-controlled sources of energy.

Thank you for your time and consideration.

Sincerely

A handwritten signature in dark ink, appearing to read "Bruce Barrett". The signature is stylized with large, sweeping loops and a long horizontal stroke at the bottom.

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

November 18, 1992

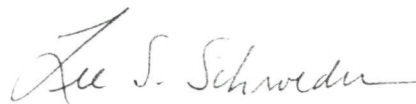
Dear Mr. Barrett:

Thank you for your recent letter concerning safety issues associated with nuclear reactors in the former Soviet Union. As you are aware, this is a very complex issue since it deals with facilities on the soil of another nation for which we have neither direct access nor control. However, there are a number of ways in which we can help make Russian reactors safer.

Currently, Russia and the United States are working toward an agreement whereby the U.S. would purchase highly enriched uranium from the Russian stockpile. Russia would then use the proceeds from such sales to improve safety at their nuclear power plants, provide peacetime jobs for their weapons scientists and help clean up the environment around their weapons factories. In a related initiative, we are sharing up-to-date nuclear reactor safety concepts and training with those responsible for reactor safety in the former Soviet Union, through representatives of the U.S. Nuclear Regulatory Commission and the nuclear power industry.

Again, thank you for your letter and the obvious thought that went into it. Safety for all nuclear reactors is an important issue, deserving constant attention.

Sincerely,



Lee S. Schroeder
Assistant Director for
Physical Sciences and Engineering

Mr. Bruce Barrett
1164 Emerald, #1
Madison, WI 53715

SEP 21 1992

"Document Control"

TYPE: ACTION DOCUMENT NUMBER: 9202848
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

FROM: DEPARTMENT OF STATE

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 09/01/92

SUBJECT: THEY ARE FORWARDING A LETTER ADDRESSED TO SECRETARY
BAKER FROM BARBARA McDOUGALL AND WILLIAM WINEGARD
REGARDING THE PROPOSED KOAN FACTORY.

DIRECTORATE STAFF
ASSIGNED: PHYSICAL SCIENCES ASSIGNED:

ACTION
REQUIRED: AS NECESSARY

STAFF
ACTION:

None: The requested meeting has taken place K.B. sub 10/6/92

SENDER'S DUE DATE:
OSTP DUE DATE: 09/30/92 STAFF DUE DATE
DATE COMPLETED: DATE COMPLETED/DEPT:

COPIES TO:

WHITE HOUSE TRACKING #: CONTACT PERSON:
PHONE: EXT:
REMARKS: REASSIGNED TO PHYSICAL SCIENCES PER INTERNATIONAL.

Received at Physical Sciences on 9/24. Note that the incoming correspondence was dated July 31, nearly two months ago.



OSTP RECEIVED: 09/03/92 DEPT RECEIVED:
FILE: P-PHYSICAL SCIENCES

CENTRAL FILES:



Logged

9202848

"Document Control"

TYPE: ACTION DOCUMENT NUMBER: 9202641
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

FROM: DEPARTMENT OF STATE

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 09/01/92

SUBJECT: THEY ARE FORWARDING A LETTER ADDRESSED TO SECRETARY
BAKER FROM BARBARA McDOUGALL AND WILLIAM WINEGARD
REGARDING THE PROPOSED KOAN FACTORY.

DIRECTORATE STAFF
ASSIGNED: INTERNATIONAL/POLICY ASSIGNED: JS

ACTION STAFF
REQUIRED: AS NECESSARY ACTION: as necessary

SENDER'S DUE DATE:
OSTP DUE DATE: 09/14/92 STAFF DUE DATE 9/14/92
DATE COMPLETED: DATE COMPLETED/DEPT:

COPIES TO: D. Allan Bromley

WHITE HOUSE TRACKING #: CONTACT PERSON:
REMARKS: PHONE: EXT:

OSTP RECEIVED: 09/01/92 DEPT RECEIVED:
FILE: EAC-CABINET
CENTRAL FILES:

"Document Control"

logged

9202848

TYPE: ACTION
ORIGINATOR: 02

DOCUMENT NUMBER: ~~9202641~~
DIRECTORATE STATUS

STATUS I

FROM: DEPARTMENT OF STATE

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 09/01/92

SUBJECT: THEY ARE FORWARDING A LETTER ADDRESSED TO SECRETARY
BAKER FROM BARBARA McDOUGALL AND WILLIAM WINEGARD
REGARDING THE PROPOSED KOAN FACTORY.

DIRECTORATE
ASSIGNED: INTERNATIONAL/POLICY

STAFF
ASSIGNED: JS

ACTION
REQUIRED: AS NECESSARY

STAFF
ACTION: *as necessary*

SENDER'S DUE DATE:
OSTP DUE DATE: 09/14/92
DATE COMPLETED: STAFF DUE DATE *9/14/92*
DATE COMPLETED/DEPT:

COPIES TO: D. Allan Bromley

WHITE HOUSE TRACKING #:

CONTACT PERSON:

PHONE:

EXT:

REMARKS:

OSTP RECEIVED: 09/01/92
FILE: EAC-CABINET

DEPT RECEIVED:

CENTRAL FILES:

U.S. DEPARTMENT OF STATE
EXECUTIVE SECRETARIAT
ACTION SLIP

Unclass
(Classification/Downgrader)

DATE: 8/14/92

DATE DUE IN S/S BY: KSCA

S/S CONTROL NUMBER

ACTION ASSIGNED TO:

9216880

ACTION REQUESTED:

STATE TO MEMO MAIL ROOM

PRESIDENTIAL

CONGRESSIONAL

HIGH PRIORITY ITEM

STATE TRANSMITTAL FORM
TO NSCS OVP

TRAVEL AUTHORIZATION

PROVIDE INFO COPY OF
DIRECT REPLY

WITH DRAFT REPLY FOR SIGNATURE
BY:

WITH COMMENT/RECOMMENDATION

IF NO SIGNED ORIGINAL IS NECESSARY,
PREPARE CROSS-HATCH CABLE.

AFTER CROSS-HATCHING, SEND A
COMEBACK COPY OF OUTGOING STATE CABLE
AND ORIGINAL WH CORRESPONDENCE,
UNDER COVER OF TRANSMITTAL FORM.

IF NO REPLY IS NECESSARY, RETURN
ORIGINAL WH CORRESPONDENCE UNDER
COVER OF A TRANSMITTAL FORM.

PROVIDE COMEBACK FOR

DIRECT REPLY ON BEHALF OF

WITH REPLY FOR SIGNATURE BY

RECOMMENDATION FOR UNDER COVER OF AN ACTION MEMO

WITH REPLY FOR SIGNATURE

FOR APPROPRIATE HANDLING FOR YOUR INFORMATION

92
AUG 13
11:08

REMARKS/SPECIAL INSTRUCTIONS:

CLEAR WITH:

COPIES TO:

☐ S	☐ S/S	☐ A	☐ HA	☐ NRRC
☒ S/SCHED.	☐ S/S-O	☐ B	☐ IL	☐ NST
☐ D	☐ S/S-EX	☐ CA	☐ IO	☒ OES
☐ D/CISA	☒ S/S-S	☐ CIP	☐ INM	☐ OIG
☐ D/EEA	☐ S/S-C	☐ CPR	☐ L	☐ PM
☐ D/P&R	☐ S/S-IRM	☐ CT	☐ M/DGP	☐ RP
☒ D/SC	☒ S/S-IRM/RMD	☐ DS	☐ MEBCO	☐ S/R
☐ P		☐ EB	☐ M/FSI	☐ ST
☐ P/FP	☐ AF	☐ EEOCR	☐ M/MED	
☐ E	☐ ARA	☐ FMP	☐ M/OFM	☐ ACDA
☐ T	☐ EAP	☐ FSG	☐ PA/WHL	☐ AID
☐ M	☐ EUR	☐ H-2	☐ NP	☐ USIA
☐ C	☐ NEA			
☐ S/P				
☐ PA				
☐ INR				

FROM:

S/S-S

TEAM: A

EXT: 7-5805/8349/8062/8063

5804/8338/8339/8348

The Secretary of State for External Affairs



Secrétaire d'Etat aux Affaires extérieures

Canada

July 31, 1992

9216880

The Honourable James A. Baker III
Secretary of State
Department of State, 7TH Floor
WASHINGTON, D.C. 20520

—Dear Secretary Baker:

It is my pleasure to inform you that the Honourable Stanley Hagen has been appointed by the Government of Canada to lead a federal-provincial delegation to international capitals, in order to seek official commitments to contribute to the capital costs of the proposed KAON Factory which is to be constructed in Vancouver, British Columbia.

The Government of Canada and the Government of the Province of British Columbia are cooperating in this project, and have made firm offers towards KAON construction costs. We are eager to begin construction of this facility which is important to Canada and important internationally. International funds are critical to KAON's future.

As you may be aware, a joint letter (copy attached), from the Honourable William Winegard, Canada's Minister for Science, and the Honourable Glen Clark, British Columbia's Minister of Finance and Corporate Relations, containing information concerning the proposed KAON Factory and seeking a formal indication of your country's support for this project was sent to the Assistant to the President on Science and Technology and your Secretary of Energy in July 1992.

At this time, your assistance is requested to ensure that Mr. Hagen and his delegation meet the most appropriate senior officials in your government in order to advance the dialogue on this topic.

I thank you in advance for your assistance in furthering this important international endeavour.

Yours sincerely,

Handwritten signature of Barbara McDougall in cursive script.

Barbara McDougall

Handwritten signature of William C. Winegard in cursive script.

William C. Winegard



MIL 10 1992

Dr. Allan Bromley
Assistant to the President on
Science and Technology
The Executive Office of the President
Old Executive Office Building, Room 358
17th St. and Pennsylvania Avenue, N.W.
Washington, D.C.
20506

Dear Dr. Bromley:

Further to our meeting at Leeds Castle, I am writing to update you on the situation regarding the KAON facility and to apprise you of our actions at this juncture to confirm international support for the project.

As you are aware, the Government of Canada and Government of British Columbia are prepared to provide contributions to the construction of the proposed KAON Factory in Vancouver, British Columbia, which, together, approximate two-thirds of the estimated 1989 capital costs of the facility.

British Columbia's Minister of Finance and Corporate Relations, the Honourable Glen Clark, has joined me in signing this letter to confirm both governments' desire to see this project advance. In order to consolidate all the funding necessary to proceed with construction, Canada is requesting that its G-7 partners signal their intent to contribute towards KAON.

...2

The United States Government, and you in particular, have continued to be a strong supporter of KAON and its construction by Canada. This commitment has been integral to our consideration of proceeding with the project. Furthermore, it is encouraging that the U.S. nuclear and particle physics community has strongly endorsed U.S. participation in KAON. We estimate that at least one-third of the 800 scientists who will perform experiments on this machine will be from the United States.

The future of KAON is at a critical stage. Without significant levels of foreign participation and contribution, this project cannot proceed. Therefore, I seek that the United States formally re-confirm the extent of its financial commitment to the capital cost of KAON.

We are eager to begin construction on this important facility and we would therefore appreciate your early response.

If you require any additional information for your decision-making, please do not hesitate to contact me.

I wish to thank you in advance for your early consideration of this significant international endeavour. I hope that we can work together to turn this unique opportunity into a reality.

Yours sincerely,



William C. Winegard



Glen Clark



JUL 10 1992

Admiral James C. Watkins, USN (Retired)
Secretary of Energy
Department of Energy
1000 Independence Avenue S.W.
Washington, D.C.
20585

Dear Admiral Watkins:

I am writing to seek a formal indication of the United States support for the proposed KAON Factory which is to be constructed in Vancouver, British Columbia. British Columbia's Minister of Finance and Corporate Relations, the Honourable Glen Clark, has joined me in signing this letter to confirm the desire of both the federal and provincial governments to see this project implemented.

As you are no doubt aware, the Government of Canada and Government of British Columbia are prepared to provide contributions to the construction of the proposed KAON Factory in Vancouver, British Columbia, which, together, approximate two-thirds of the estimated 1989 capital costs of the facility. In order to consolidate all the funding necessary to proceed with construction, Canada is requesting that its G-7 partners signal their intent to contribute towards KAON.

The United States nuclear and particle physics community has strongly endorsed KAON and its construction by Canada. The April 1992 Report of the Subcommittee on the Implementation of the 1989 Long Range Plan for Nuclear Science noted that United States involvement in the facility construction and detector development is a cost effective strategy to meet American scientific objectives. We estimate that at least one-third of the 800 scientists who will perform experiments on this machine will be from your country.

...2

At a recent Carnegie Commission meeting in the United Kingdom, I spoke with Dr. Allan Bromley regarding KAON. He reaffirmed the United States Government's, as well as his personal support, for KAON. I have since written to him as well on this subject.

The future of KAON is at a critical stage. Without significant levels of foreign participation and contribution, this project cannot proceed. Therefore, I seek that the United States, and in particular the Department of Energy, formally confirm the extent of its financial commitment to the capital cost of KAON.

We are eager to begin construction on this important facility. A team is being established to undertake discussions leading to formal negotiations with potential international contributors. We anticipate that meetings will commence within the next few weeks. Your office will be contacted to discuss details of the meeting and to arrange a suitable date.

If you require any additional information for your decision-making, please do not hesitate to contact me.

I wish to thank you in advance for your early consideration of this significant international endeavour. I hope that we can work together to turn this unique opportunity into a reality.

Yours sincerely,



William C. Winegard



Glen Clark

"Document Control"

TYPE: ACTION DOCUMENT NUMBER: 9202371
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

FROM: MANDRILLON, P.: CENTRE ANTOINE LACASSAGNE

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 08/30/92

SUBJECT: HE IS WRITING REGARDING THE BEVALAC FACILITY.

DIRECTORATE STAFF
ASSIGNED: PHYSICAL SCIENCES ASSIGNED:

ACTION STAFF
REQUIRED: DIRECT REPLY ACTION:

SENDER'S DUE DATE:
OSTP DUE DATE: 08/27/92 STAFF DUE DATE
DATE COMPLETED: DATE COMPLETED/DEPT: 9/4/92

COPIES TO: D. Allan Bromley

WHITE HOUSE TRACKING #: CONTACT PERSON:
REMARKS: Dr. Erb responded. PHONE: EXT:

OSTP RECEIVED: 08/14/92
FILE: P-PHYSICAL SCIENCES

DEPT RECEIVED: AUG 17 1992

CENTRAL FILES:



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

September 4, 1992

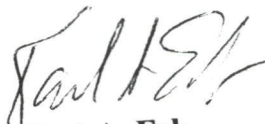
Dear Dr. Mandrillon:

I am writing in response to your letter to Dr. Bromley concerning plans by the Department of Energy to terminate BEVALAC operations. I was interested to read your account of the contributions the BEVALAC has made in this area.

The DOE is responding to the fact that its nuclear physics research program, which has provided most of the funding to operate the BEVALAC, is increasingly turning its attention to other facilities. Given this declining nuclear physics interest, the Department has attempted to ascertain whether other users of the BEVALAC find the facility sufficiently important to their activities to provide funds to sustain BEVALAC operation. To date, no other science community or funding agency has expressed that degree of interest.

If the situation changes and funds from medical or other programs become available to support the BEVALAC, the DOE will reevaluate its plans to close the facility. Thank you for your letter and the information it contains.

Sincerely,



Karl A. Erb

Associate Director for
Physical Sciences and Engineering

Dr. P. Mandrillon
Centre Antoine Lacassagne
Laboratoire du Cyclotron
227 Av. de la Lanterne
F-06200 NICE
FRANCE

CENTRE ANTOINE LACASSAGNE
LABORATOIRE DU CYCLOTRON
227 AV. DE LA LANTERNE
F-06200 NICE

☎ : (33) 93-18-03-09

Fax : (33) 93-18-04-33

Nos réf. : PM/72.07.92

Nice, 30 July 1992

RECEIVED
9/1/92 11:15
CSTP
MAIL ROOM

2371
Dr Allan BROMLEY
Assistant to the President for Science and
Technology,
Director, Office of Science and
Technology Policy
Room 360, Old Executive Office Building
17th & Pennsylvania Avenue, NW
WASHINGTON, DC 20500 - U.S.A.

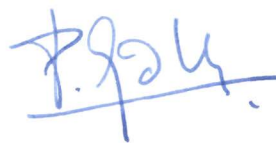
Dear Dr Bromley,

The Bevalac under the leadership of Dr Joseph Castro has for more than 15 years undertaken superb pioneering work in the treatment of malignant tumours with charged particle beams. This is the first and only facility for these studies and the work of the team is world famous.

Most promising results have been obtained for combatting one of the most serious diseases.

In the interests of humanity I urge you to keep the Bevalac running until an alternative source of these beams is available.

Yours sincerely,



P. MANDRILLON
Head of the Medical
Cyclotron Laboratory

"Document Control"

TYPE: ACTION

DOCUMENT NUMBER: 9202841

ORIGINATOR: 02

STATUS I

DIRECTORATE STATUS

FROM: SCHUMACHER, Jim

SEP 24 1992

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 08/29/92

SUBJECT: HE IS WRITING REGARDING THE SEIZURE OF THE
TYRANNOSAURUS REX REMAINS FROM THE BLACK HILLS
INSTITUTE.

DIRECTORATE

STAFF

ASSIGNED: PHYSICAL SCIENCES

ASSIGNED:

ACTION

STAFF

REQUIRED: DIRECT REPLY

ACTION:

SENDER'S DUE DATE:

OSTP DUE DATE: 09/30/92

STAFF DUE DATE

DATE COMPLETED:

DATE COMPLETED/DEPT: 9/30/92

COPIES TO: D. Allan Bromley

WHITE HOUSE TRACKING #:

CONTACT PERSON:

PHONE:

EXT:

REMARKS: Dr. Eib requested w/ form letter #2,



OSTP RECEIVED: 09/22/92
FILE: P-PHYSICAL SCIENCES

DEPT RECEIVED:

CENTRAL FILES:



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

September 30, 1992

Dear Mr. Schumacher:

I am writing to update you on the status of the Tyrannosaurus rex skeleton which you inquired about earlier.

The Office of Science and Technology Policy advises the President and the Federal agencies on issues pertaining to science and technology. As such, our concern, initially, was that the scientific value of the skeleton might be diminished as a result of the FBI action. We have made a number of inquiries regarding the storage and care of the skeleton, and have been provided with information to the effect that, with the care it is now being given, the fossil is unlikely to suffer irreparable damage in the future.

Our office is not in a position to comment on the legal and other non-science issues you raised in your letter.

Thank you for your interest.

Sincerely,



Karl A. Erb
Associate Director
for Physical Sciences and Engineering

Mr. Jim Schumacher, Attorney
P.O. Box 495
Hill City, SD 57745

2841

Jim Schumacher, Attorney
P. O. Box 495
Hill City, SD 57745
August 29, 1992

D. Allan Bromley
Assistant to the President
Office of Science & Technology
Executive Office building
Washington, DC 20540

Re: "Sue" the world's largest and best Tyrannosaurus Rex

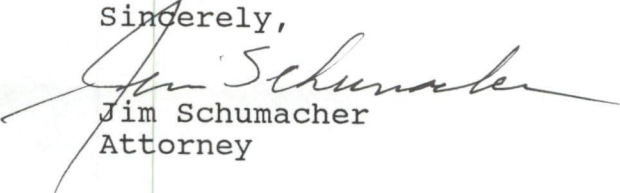
Dear Mr. Bromley:

Sue is the world's largest Tyrannosaurus Rex and was discovered by commercial collectors, The Black Hills Institute of Geological Research of Hill City, South Dakota. I am not only protesting the confiscation of "Sue" from the Black Hills Institute, but the outrageous manner in which it was done. It was not necessary to involve armed FBI agents and the South Dakota National Guard.

The United States Federal Government through Federal Judge Dick Beatty, Senator Larry Pressler and his appointee for U. S. Attorney, Kevin Schieffer, has been embarrassed beyond repair, because of the idiotic manner in which Shieffer has handled the seizure of "Sue."

The people of the Black Hills Institute are hard working, honest, patriotic Americans, and have earned the respect of the world's scientific community. A great injustice has been done. Sue should never have been seized by the Feds. A poll showed that 75% of the people were outraged, and most everyone admits the manner in which it was done was shocking and a reminder of Nazi Germany. 16,000 signatures have been collected to give Sue back to the Black Hills Institute. I have enclosed some articles.

Sincerely,


Jim Schumacher
Attorney

Hearing To Determine Sue's Temporary Custody

Judges in the Eighth Circuit Court of Appeals issued a ruling last week ordering U.S. District Judge Richard Battey to hold a hearing as soon as possible to determine where the bones of Sue T.rex will reside until final ownership can be determined. That hearing will be held July 9th and 10th in federal court in Rapid City.

The hearing for determining ultimate ownership is set for mid-November.

The fossil has been stored at the School of Mines in Rapid City since it was seized from the Black Hills Institute of Geological Research in Hill City on May 14th. The School of Mines has since been dropped from BHI's suit seeking return of the fossil because the university has stated it never claimed ownership.

The parties involved are to try and reach an agreement as to where the fossil should temporarily reside. But an agreement is unlikely between BHI, the Cheyenne River Sioux and U.S. Attorney Kevin Schieffer acting for the federal government.

The Eighth Circuit Court said there wasn't sufficient reason for the seizure of the actual bones in the case. But they did not determine where the bones should be kept until ownership is resolved. Rather they ordered the hearing set for next week.

The ruling from Judges John R. Gibson, C. Arlen Beam and Frank Magill fairly blasted how the seizure was handled. Here are a few excerpts from the nine-page ruling, written by Judge Frank Magill.

"This case concerns the care and custodianship of a 65 million-year-old pile of bones named Sue. Ever since researchers uncovered the mammoth remains of a Tyrannosaurus rex in western South Dakota in August, 1990, the ten tons of bones have sparked a keen ownership battle. Federal agents seized the bones on May 14, 1992, on orders of the United States Attorney for the District of South Dakota as part of an investigation into possible violation of the Antiquities Act.

"The ownership of these bones is not before this court. Rather, appellants sought a preliminary injunction requiring the federal government to return the fossil to them for safekeeping until the ownership question is answered. The motion was based on a claim that the fossil is being irreparably damaged in the government's hands because of a lack of expertise in handling the archaeological exhibit."

The ruling goes on to give a synopsis of legal actions prior to the appeal and a short history of the fossil's discovery, excavation and shipment to Hill City. It mentions how the fossil was turned over to the non-profit Black Hills Museum of Natural History Foundation.

After citing some prior legal rulings in other cases where search and seizure was questioned, the ruling says, "Therefore, this court looks not to the legality of this seizure, but the reasonableness of it." It goes on... "The rationale for the seizure of this priceless archeological treasure was based on an investigation into criminal charges that could result in, at most, 90 days in jail and a \$500 fine. The seizure came nearly two years after the bones were found and excavated under the glare of worldwide publicity. The federal government has stored this irreplaceable relic under circumstances its own experts describe as inadequate. Moreover, the government has admitted it does not need the 10 tons of bones for evidence in its criminal investigation..." The ruling states the BHI agrees where the fossil was found, what it is, and to provide the documentation needed in the government case.

The ruling continues: "Based on these facts, we find the government's rationale for the seizure inadequate. The seizure not only keeps the appellants (BHI) from accessing the fossil, but deprives the public and the scientific community from viewing and studying this rare find. In fact, a test on the fossil by the National Aeronautics and Space Administration was cancelled because of the seizure. Therefore, this factor militates strongly in favor of equitable relief."

"The government does not need to retain as evidence the fossil which the government itself described as 'priceless' in order to preserve the evidence in a petty misdemeanor criminal prosecution. The presence of the evidence is conclusive and well-documented. No one would seriously suspect that the Foundation intends to destroy the fossil. But even if the fossil was lost or destroyed, it would have no impact on any criminal investigation."

The ruling concludes: "We remand the district court to hold a hearing at its earliest possible convenience to determine the proper temporary custodian for the dinosaur bones pending final disposition on the main action to determine ownership. The district court may also take any steps necessary to preserve evidence in any criminal prosecution stemming from the find and may allocate costs associated with any transportation or storage found necessary."

Sue Debate To Appear On National TV

The TV show "Prime Time Live" was in Hill City Wednesday, for filming comments from local residents and officials about the seizure of the T.rex fossil "Sue." Mayor Drue Vitter was interviewed and location segments were filmed at the Black Hills Institute.

The TV series is also expected to interview Gregg Bourland of the Cheyenne River Sioux, and state and federal officials about the seizure and fossil ownership.

The show will also air controversy that has arisen about the planned improvements at Mount Rushmore, and filming was done there and in Keystone. The TV crew is expected to be in South Dakota for three days.

Sue T. Rex Protest Rally

Opening speech by Gus Hercules, M.D. At the Federal building in Pierre, Monday, June 15th, 1992

Welcome to the Sue T. Rex protest rally. We have gathered here from all around the state to publicly protest the confiscation of a T. Rex dinosaur named "Sue", and to rally the forces of fairness and freedom to peacefully fight this unbelievable injustice. Regardless of the final outcome of who gets custody of the fossil remains of Sue, we have another flagrant example of government officials abusing their power.

U.S. Attorney, Kevin Schieffer, and his colleagues have insensitively ignored both reasonable due process and basic human decency through their abusive approach to settling a dispute.

What was his (ir)rational? That somebody would cleverly conceal "Sue's" bones in the lining of a suitcase and abscond to sell them in the illegal dinosaur bone market to some underground private collector.

Pertinent sections of the Black Hills Institute of Geological Research, Inc. could have easily been sealed off or even guarded till the dispute was settled by mediation or in court.

And what about the trauma to the Hill City children who had their beloved dinosaur snatched from their dreams without warning by a callous and misguided government official?

And what about the citizens who have sincerely and conscientiously worked to establish a non profit museum?

Whatever the legal outcome, this confiscation was unwarranted. The U.S. Attorney's office owes all concerned an apology for its misguided abuse of power. Members of the Black Hills Institute of Geological Research, Inc. and their families, the children and citizens of Hill City, of the Black Hills and of South Dakota all have been abused. And all citizens should recognize this for what it actually is, another instance in the never ending array of government callousness, insensitivity and abuse of power.

The ill conceived and misused search warrant that the US Attorney used to invade the Institute contains the term "concealed" to describe that which was sought. Concealed generally means hidden from sight, often with an intent of secrecy. Sue T. Rex's location was anything but concealed or secret. The skull was already scheduled to be sent to a government agency for scientific study. With this in mind, how can these actions be viewed by the public as anything other than an abuse of Amendment IV of the Bill of Rights" protection from unreasonable search and seizure? This is king of abuse that America's founders wanted to prevent with this amendment.

Acting U.S. Attorney Kevin Schieffer offered a "policy basis" for actions taken: a hindsight "policy" explanation by a government official is too often the equivalent of makeup to an actor. Both are something put on to cover up blemishes or mistakes or to project an unreal image. "Policy" does not excuse a callous abuse of government authority.

The 1906 Antiquities Act, used to justify this abuse, is vague and is applied inconsistently and capriciously. The Federal Government is interpreting this Act retroactively to suit its own objectives. In order to save face, the federal government is now on a random hunt to find reasons to justify its own abusive actions after the fact.

I'm neither a lawyer nor an attorney, so I do not claim to understand abstruse legal intricacies. But as an M.D. and psychiatrist, I do understand the distress and harm that are caused to our citizens and society when government behavior and explanations defy common sense.

The Feds have already squandered and destroyed the value that has been added to Sue T. Rex and now we, the taxpayers are paying for added costs. And for what! To settle a dispute that could have been handled through mutual cooperation and mediation!

As the US Attorney uses the search warrant to justify a fishing expedition through the records of BHIGR, it has alluded to possible criminal charges. Even if, and this is a big "IF", any "criminal acts" were unwittingly committed, the punishment inflicted by our government has already

exceeded the alleged crime. Through its legal system, the US Government has already caused excessive physical, emotional, mental and economic damage to many innocent people.

And as usual, nobody within government has been held accountable for it. Only the federal government and the special interests it represents are immune from liability for their destructive actions. If anyone deserves to be the subject of an investigation, it is the U.S. Attorney's office and its silent government accomplices who participated in this disgusting display of KGB-style tactics.

• Trust is the glue which binds us together as communities, a state and a nation. Through this unjustified behavior, trust of the US Government has been further shattered. Trust of the FBI, National Guard and the School of Mines has been damaged. And trust of state government has been hurt because of its silence and inaction.

• I ask every public official in South Dakota from our Governor, State's Attorney, tribal leaders, mayors, county commissioners, school board members and all concerned citizens to join us and publicly speak out against this abuse. Let us unite to correct these wasteful and hurtful injustices and regain our autonomy from the out-of-control police state that our federal government is becoming.

Join us! Join us! Join us, now, before it's too late.

TYPE: ACTION
ORIGINATOR: 02

DOCUMENT NUMBER: 9202672
DIRECTORATE STATUS

STATUS I

FROM: GLASS, Alexander: LAWRENCE LIVERMORE NATIONAL LABORATORY

TO: DR. D.A. BROMLEY

SEP 10 1992

DATE OF
CORRESPONDENCE: 08/28/92

SUBJECT: HE IS FORWARDING INFORMATION REGARDING HIS MEETING
WITH DR. BROMLEY.

DIRECTORATE

STAFF

ASSIGNED: PHYSICAL SCIENCES

ASSIGNED:

ACTION
REQUIRED:

AS/IF NECESSARY

STAFF
ACTION:

Note: Dr Bromley & KAE met with Dr Glass.

SENDER'S DUE DATE:

OSTP DUE DATE: 09/23/92

STAFF DUE DATE

DATE COMPLETED:

DATE COMPLETED/DEPT: 9/11/92

COPIES TO: D. Allan Bromley
NATIONAL SECURITY

WHITE HOUSE TRACKING #:

CONTACT PERSON:

PHONE:

EXT:

REMARKS: PLEASE NOTE POSTMARK ON ENVELOPE.

OBE -

OSTP RECEIVED: 09/09/92
FILE: P-PHYSICAL SCIENCES

DEPT RECEIVED:

CENTRAL FILES:



Withdrawal/Redaction Sheet

(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01. Letter	To: Allan Bromley From: Alexander Glass Re: Information regarding meeting with Bromley (2 pp.)	8/28/92	(b)(1)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: General Science Files
WHORM Cat.:
File Location: Physical Sciences: General (1) [3 of 7] [1992]

Date Closed:	3/19/2010	OA/ID Number:	62042-003
FOIA/SYS Case #:	2005-0336-F	Appeal Case #:	
Re-review Case #:		Appeal Disposition:	
P-2/P-5 Review Case #:		Disposition Date:	
AR Case #:		MR Case #:	
AR Disposition:		MR Disposition:	
AR Disposition Date:		MR Disposition Date:	

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

P-1 National Security Classified Information [(a)(1) of the PRA]
P-2 Relating to the appointment to Federal office [(a)(2) of the PRA]
P-3 Release would violate a Federal statute [(a)(3) of the PRA]
P-4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
P-5 Release would disclose confidential advice between the President and his advisors, or between such advisors [(a)(5) of the PRA]
P-6 Release would constitute a clearly unwarranted invasion of personal privacy [(a)(6) of the PRA]

C. Closed in accordance with restrictions contained in donor's deed of gift.

PRM. Removed as a personal record misfile.

Freedom of Information Act - [5 U.S.C. 552(b)]

(b)(1) National security classified information [(b)(1) of the FOIA]
(b)(2) Release would disclose internal personnel rules and practices of an agency [(b)(2) of the FOIA]
(b)(3) Release would violate a Federal statute [(b)(3) of the FOIA]
(b)(4) Release would disclose trade secrets or confidential or financial information [(b)(4) of the FOIA]
(b)(6) Release would constitute a clearly unwarranted invasion of personal privacy [(b)(6) of the FOIA]
(b)(7) Release would disclose information compiled for law enforcement purposes [(b)(7) of the FOIA]
(b)(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
(b)(9) Release would disclose geological or geophysical information

"Document Control"

TYPE: ACTION DOCUMENT NUMBER: 9202664
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

FROM: COULSUN, Danny O.: U.S. DEPARTMENT OF JUSTICE, FBI SEP 10 1992

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 08/27/92

SUBJECT: HE IS RESPONDING TO DR. BROMLEY'S LETTER REGARDING
THE REMAINS OF THE TYRANNOSAURUS REX SEIZED FROM THE
BLACK HILLS INSTITUTE.

DIRECTORATE
ASSIGNED: PHYSICAL SCIENCES

STAFF
ASSIGNED: Dan Cranmer
Came to to rate, please

ACTION
REQUIRED: AS/IF NECESSARY

STAFF
ACTION:

SENDER'S DUE DATE:

OSTP DUE DATE: 09/23/92

STAFF DUE DATE

DATE COMPLETED:

DATE COMPLETED/DEPT: 9/30/92

COPIES TO: D. Allan Bromley

WHITE HOUSE TRACKING #:

CONTACT PERSON:

REMARKS:

De. Eib responded -

PHONE:

EXT:

OSTP RECEIVED: 09/09/92
FILE: P-PHYSICAL SCIENCES

DEPT RECEIVED:

CENTRAL FILES:



**EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506**

September 30, 1992

Dear Mr. Coulson:

Thank you for your August 27th response to Dr. Bromley's letter concerning the Tyrannosaurus Rex skeleton in South Dakota. We in OSTP were relieved to learn of Judge Battey's finding that the skeleton is being looked after in a manner that will preserve its scientific value.

I would appreciate your alerting our office of any further developments in this case.

Sincerely,

A handwritten signature in black ink, appearing to read 'Karl A. Erb', with a long horizontal stroke extending to the right.

**Karl A. Erb
Associate Director
for Physical Sciences and Engineering**

**Mr. Danny O. Coulson
Deputy Assistant Director
Criminal Investigative Division
Federal Bureau of Investigation
U.S. Department of Justice
Washington, D.C. 20535**



U.S. Department of Justice

Federal Bureau of Investigation

RECEIVED

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Washington, D.C. 20535

August 27, 1992

OSTP
MAIL ROOM

BY LIAISON

Honorable D. Allan Bromley
The Assistant to the President
for Science and Technology
The White House
Washington, D.C.

Dear Mr. Bromley:

Director Sessions asked me to respond to your August 5th letter regarding our recent seizure of the Tyrannosaurus Rex skeleton from the Black Hills Institute of Geological Research, Inc., in South Dakota. We appreciate your interest in writing and your offer of assistance in ensuring that this skeleton is properly cared for.

I am sure you will be pleased to learn that from July 9 through 13, 1992, an evidentiary hearing was held in Rapid City, South Dakota, before United States District Court Judge Richard H. Battey, to determine if the skeleton was being stored under safe conditions necessary for proper preservation. Numerous individuals from the scientific community testified, and the hearing concluded by Judge Battey stating that the Tyrannosaurus Rex is being properly cared for at its current location and should remain there.

In view of your interest and that of the scientific community, I am enclosing a copy of the Supplemental Findings of Fact and Conclusions of Law issued by the Court.

Sincerely yours,

Danny O. Coulson
Deputy Assistant Director
Criminal Investigative Division

Enclosure

FILED

JUL 16 1992

UNITED STATES DISTRICT COURT
DISTRICT OF SOUTH DAKOTA
WESTERN DIVISION

BLACK HILLS INSTITUTE OF
GEOLOGICAL RESEARCH; and
BLACK HILLS MUSEUM OF
NATURAL HISTORY FOUNDATION,
INC., a nonprofit corporation,

Plaintiffs,

vs.

THE UNITED STATES OF AMERICA,
DEPARTMENT OF JUSTICE,

Defendant,

and

THE CHEYENNE RIVER SIOUX
TRIBE,

Amicus curiae.

CIV. 92-5070

SUPPLEMENTAL
FINDINGS OF FACT AND
CONCLUSIONS OF LAW

At the conclusion of the evidentiary hearing in the above-entitled matter held pursuant to the instructions of the Eighth Circuit Court of Appeals,¹ the Court issued its order dated July 13, 1992, granting temporary custody of evidence and setting conditions.

The Court now files its written findings of fact and conclusions of law.

¹No. 92-2252SD slip op. (8th Cir. 1992)

In determining the issue of irreparable damage, the Court starts from the law of the case that plaintiffs clearly have made at least a prima facie showing that damage is probable. (No. 92-2252SD slip op. at 6).

FINDINGS OF FACT

A. Conditions from discovery to seizure (August 12, 1990, to May 18, 1992).

1. The following terms are defined: "Paleontology" is the science that deals with the life of the past geological periods. It is based on the study of fossil remains of plants and animals and gives information about the phylogeny and relationships of modern animals and plants and about the chronology of the history of the earth. Webster's Third International Dictionary. "Conservation" is the descriptive word relating to the ongoing process of cleaning and gluing a fossil for final preservation. "Curation" is another commonly used word by commercial and scientific paleontologists which refers not only to the process of conservation, but also the making sure that the fossil is available for public viewing and scientific education. "Preservation" is a term used to describe the process of restoring and "curating" a fossil.

2. The fossil, which has been named "Sue" after its discoverer, is a 65 million year old Tyrannosaurus rex skeleton. It is the largest and most complete skeleton known to man. It was discovered somewhat inadvertently by Sue Hendrickson of the Black Hills Institute of Geological Research (BHIGR), who was in the process of assisting in the excavation of a separate and independent site.

3. The site upon which the fossil was found is within the exterior boundaries of the Cheyenne River Sioux Indian Reservation. Ownership interests have not yet been

determined. At this time ownership is not relevant. This is an action in equity to determine only the issues outlined by the Court of Appeals.

4. BHIGR is a commercial dealer in paleontological specimens such as the *Tyrannosaurus rex*. By virtue of the discovery, BHIGR claimed an "individualized interest in the fossil." (Paragraph XIV of second amended complaint). It has since transferred all its right in the fossil to the Black Hills Museum of Natural History Foundation, Inc. BHIGR has a wide-ranging reputation in the marketing of all kinds of paleontological specimens. It has furnished specimens to all major museums of the world. It is knowledgeable in the curation and preservation of such antiquities.

5. The excavation, packaging, and storage of the fossil took seventeen days. It was transported in pieces from its discovery site on the Cheyenne River Sioux Indian Reservation to Hill City, the location of BHIGR. As the pieces of fossil arrived in Hill City, they were placed on storage shelves to await the process of conservation, preservation, and curation.

6. Hill City is a small community in the Black Hills of South Dakota. It is located a few miles from Mount Rushmore and approximately thirty miles southwest of Rapid City, the second largest city in South Dakota. Millions of tourists pass through the Black Hills every year. Many of these tourists pass through Hill City on their way from Rapid City to Mount Rushmore.

7. The building in which the fossil Sue was housed at BHIGR was what may be generally characterized as of "pole barn type" construction. It has metal walls supported by wall beams which have been placed upon cement footings. The floor is cement. The

interior consists principally of sheetrock walls with one wall of plywood. Part of the rear of the building protrudes into an earthen bank. The building is an all-weather structure. It has a furnace, duct work, and electrical wiring. It has no central air conditioning or humidity control capability. Initially there was no monitoring device for temperature or outside pollutants which could enter the building through the windows or doors. It has no fire suppression capability or environmental control. The internal cooling was conducted by opening the doors with the resultant entrance of outside pollution. It is this building in which BHIGR proposes to house the specimen if returned. The physical location at BHIGR was not immediately changed to accommodate such an important paleontological find. It was not until after seizure and removal with the resultant struggle over its possession that BHIGR started to make changes to its facilities in order to properly address the specific needs of care and protection of the fossil. Changes to accommodate the fossil continued even as the hearing was being conducted. South Dakota School of Mines and Technology (SDSM&T) has also continued to make changes necessary to meet the requirements of safe accommodation of the fossil.

8. Plaintiffs began working on the conservation and restoration of the fossil. The work continued for approximately twenty-one months before the fossil was seized by the United States on May 18, 1992. During this time, approximately 5,000 hours of labor were performed. Expenses were incurred in the approximate amount of \$100,000. It is estimated that it will take an additional 25,000 hours and as much as \$500,000 more in funds to complete the restoration and curation of the fossil. It is intended that the \$600,000

anticipated investment will be recaptured principally by sales of molds and castings. A complete mold and casting of a Tyrannosaurus rex would sell for as much as \$100,000.

Parts of the fossil remained in storage while the actual work of restoration was being completed on other parts. The estimate of 5,000 hours in twenty-one months constitutes an average of approximately 240 hours per month. At that rate of progress, it would take approximately ten years to complete the restoration. During this period of time much of the fossil would be in storage. BHIGR states it desires to accelerate the process to two years. Such an accelerated timetable, if permitted by the Court, would mean that BHIGR would complete the restoration before the question of ownership had worked its way through the judicial system. The Court accordingly finds that it is not in the best interest of all parties and the public to permit the restoration to proceed. The mission of the Court is to determine temporary custody and to provide conditions of care. Some conservation and preservation measures may be permitted under Court-imposed conditions.

B. Conditions from seizure to present.

9. Involved in the seizure on May 18, 1992, were Department of Justice personnel; United States Marshal Service; members of the South Dakota National Guard; Rachael Benton, Museum Specialist, National Park Service; and Janet Whitmore, M.S., paleontology, of SDSM&T. Benton and Whitmore were experts obtained to see that damage to the property did not occur. They were knowledgeable about the collecting, packaging, and storing of the paleontological antiquities.

10. The seizure took approximately three days. Peter Larson, president, and other BHIGR employees also assisted. Peter Larson is a graduate of SDSM&T, having graduated

in 1974 with B.S. degree in geology. Assisting also was David A. Burnham, curator for BHIGR. Burnham is a specialist with a M.S. in geology (discipline in vertebrate paleontology). Both Larson and Burnham are members of the Society of Vertebrate Paleontology (SVP).

11. The selection, packaging, and loading of the specimen proceeded with extreme care. All persons participating were sensitive to the fact that this evidence was highly fragile and constituted a paleontological find of the highest scientific magnitude.

12. In the packaging and loading of the evidence, the advice of Peter Larson, David Burnham, and their staff was sought and followed. Due deference was given to any advice which they provided. The use of a "bubble" and "foam" packaging material was specifically recommended by Burnham and adopted. Plaster castings were used to maintain the integrity of the fossil, making sure that there would be no infusion of plaster into the fossil itself. Appropriate screening material was used to prevent a later "marriage" between the fossil and its plaster casing. The Court finds that the greatest concern was to avoid damage to this fossil.

13. Despite the extraordinary measures taken to avoid damage to the fossil, an individual fossil, a post-orbital bone (skull bone) was damaged. This occurred when Peter Larson moved the post-orbital bone from the table to the floor. Larson leaned the skull against the wall and thereafter a pallet fell on the bone, causing it to be broken in four pieces. The Court does not fault Larson for this damage. It was the natural result of the delicate process of moving fragile fossils. Another fossil may have suffered damage when

a forklift operator moved the specimen by depositing it somewhat roughly on its carrier. No physical examination of this specimen was done to determine any resultant damage.

14. The fossil was transported from Hill City to Rapid City. It was stored on the campus of SDSM&T. The building is of cement construction. It is what was commonly referred to by counsel as a "machine shop." The fossil was placed in an 8' x 8' x 40' steel "shipping container" similar to a common semi-trailer. Steam boilers are housed in a separate room within the building about 60 feet from the storage container. A sheetrock wall separates the boiler room from the other room. The boilers are regularly maintained and inspected daily. Annual inspections by the Hartford Insurance Company occur annually. There is no reasonable cause to anticipate danger from the boilers. Adjacent to the boilers are chemicals which are used for water treatment of the interior of the boiler pipes. Water softening chemicals are stored in the boiler room. They release no vapor, are inert, and pose no danger to the fossil. There is no problem with rodents or insects either in the building or the storage container. The building is structurally sound. Twenty-four hour security is provided as a part of the overall campus security system. The building and its container provide a damage-free environment.

15. SDSM&T is one of seven state-supported institutions of higher learning in the state of South Dakota. It was established in 1885 to provide instruction in mining engineering in western South Dakota where mining was a primary industry. It now has an expanded role in areas of science, technology, and liberal arts.² It has seven engineering

²The Division of Engineering provides departments in chemical, civil, electrical, geological, industrial, mechanical, metallurgical, mining, and general engineering. The Division of Science and Humanities is composed of biology, chemistry, geology,

and five science undergraduate degrees and graduate programs leading to the master of science degree in fourteen engineering and/or science disciplines. In addition, programs are available leading to the doctor of philosophy degree in geological engineering, geology, and materials engineering and science. (Exhibit 113).

SDSM&T is located in Rapid City, South Dakota, in the foothills of the Black Hills in the southwestern part of the state. The locality is rich in natural history, with an abundance of rocks and minerals, wildlife and plant life indigenous to the area. The Badlands area located to the east offers some of the most prolific sources of fossils.

16. The Court takes judicial notice that SDSM&T enjoys a nationwide, if not an international, reputation for quality.

17. SDSM&T is involved in paleontology. It teaches a course in invertebrate paleontology, offering a masters of science degree in paleontology.

18. SDSM&T maintains a museum of geology. Thousands of specimens, especially pertaining to the fields of vertebrate paleontology and mineralogy are on public display or in research collections. The museum possesses skeletons from the Oligocene era of the Big Badlands and Upper Cretaceous era of western South Dakota. Research collections of mid-terrian vertebrates are added from time to time. The museum is closely associated with the Department of Geology and Geological Engineering and the collections form the basis of staff and student research. (Exhibit 113).

interdisciplinary sciences, liberal arts, mathematics, computer science, meteorology, nursing, physical education, and physics.

19. On the issue of irreparable damage and representations and evidence of proper temporary location for the fossil, plaintiffs presented three nonparty expert witnesses, Donald L. Wolberg, Andrew Leitch, and Bob Bakker.

Donald L. Wolberg

20. Donald L. Wolberg is a paleontologist from New Mexico Bureau of Mines and Mineral Resources and an adjunct associate professor of geology, Geosciences Department, New Mexico Institute of Mining and Technology at Socorro, New Mexico. He has a Ph.D. in geology from the University of Minnesota. Dr. Wolberg stated he was "appalled" at the conditions under which the fossil was stored. He pointed out ten specific harms which he considered established harm or potential harm to the fossil:

(a) Nearness of a rail line. The Court finds this to be de minimis. The single rail line is across the road. Upon it travels slow-moving freight trains.

(b) Building in which housed was in Rapid City floodplain. This objection is illusory. It typifies the extreme to which this and other of plaintiffs' experts exaggerate their testimony to convince the Court to remove the fossil from SDSM&T. In 1972 a disastrous flood occurred in the residential and business districts of Rapid City. Loss of life (238) and property damage in the millions were caused. The flood was caused by the combination of a deluge of rainfall and the failure of earthen dams on Rapid Creek. Rapid Creek meanders from west to east through some residential areas and the downtown area of Rapid City. Its course has been established as a floodplain to permit the construction of certain types of structures and the exclusion of others. Currently within the floodplain are two golf

courses, several parks, Baken Park Shopping Center, Rapid City Central High School, elementary schools, Rapid City Civic Center, Rushmore Plaza Holiday Inn, and other businesses. Steps have been taken to prevent the recurrence of such a disaster.

(c) No full-time protection which provided ease of access.

(d) Intense heat of 90 degrees and high humidity. This Court finds that up to and including the date of the hearing, both BHIGR and SDSM&T were working to install equipment to address the very important problems of humidity and temperature control. The care of this fossil will be an ongoing responsibility of whomever has temporary custody.

(e) Building described as a machine shop by counsel for plaintiffs;

(f) Steam boiler in an adjoining room.

(g) Building within fifty yards of a gasline tree.

(h) Presence of electrical equipment panel.

(i) Presence of canisters of caustic materials.

(j) Storage in metal containers which may interact with chemical lining.

Wolberg's conclusion was that the fossil is suffering irreparable harm. It was further his opinion that the fossil was inflicted with pyrite disease.³ Dr. Wolberg also was of the

³Pyrite disease is the forming of pyrite crystals on the fossil which if left unchecked through a process of oxidation would ultimately cause its destruction. It is referred to by plaintiffs' witnesses as similar to "cancer" in humans and is called "fossil cancer." In fact, it is neither cancer nor is it a disease. It is a condition which can be arrested by proper care and treatment. Its prevention or extension is prevented principally by proper temperature and humidity control.

opinion that SDSM&T was not suitable because it was not properly caring for the Tyrannosaurus rex which it had in its museum. The Court finds this statement disingenuous and reflects immense bias, robbing this witness of still more credibility. His final conclusion was that the fossil should be returned to BHIGR because it has the equipment, expertise, and familiarity with the fossil needed to prevent irreparable injury.

The Court observed that Dr. Wolberg seemed completely unable to answer any question responsively, especially upon cross-examination. He was biased to the point that he could not make even the simplest common sense concession. Based upon his demeanor and apparent bias in favor of plaintiffs, the Court finds his testimony completely lacking in credibility. His opinion as to the presence of pyrite disease appeared to be a late-hour attempt to establish a claim of irreparable injury. Plaintiffs possessed the fossil for twenty-one months, and not once was there shown to have been documented the existence of such a condition. The claim as to the existence of pyrite oxidation was not charged until the time of the hearing. Pyrite oxidation is a serious debilitating condition, and the failure to communicate knowledge of the presence of pyrite oxidation would be a measure of the highest scientific irresponsibility. The plaintiffs, if as concerned as they professed to be of the well-being of this rare find--described as a "Mona Lisa" or a "Rembrandt"--surely would have made known to those who possess the fossil that it had fossil's "cancer." This Court finds that the interests of plaintiffs and their expert witnesses Wolberg and others are more commercial than scientific. Their interest in science is secondary to the financial value of the fossil's possession.

Dr. Wolberg is a personal friend of Peter Larson. He characterized his friendship as that of a "close personal friend." The two have worked together on federal regulatory matters and lobbied the appointment of a candidate for the United States Geological Services and the Bureau of Land Management of the United States Park Service.

Andrew Leitch

21. Andrew Leitch has a bachelor of science degree. He is a contract paleontologist from Toronto, Canada. He formed Leitch Museum Consulting for the purpose of supplying specific scientific and exhibit information to institutions regarding exhibit, funding, and cost analysis. He is also president of various companies which have as their mission the harvesting of dinosaur and fossil skeleton material. Dinoworks, Ltd., of which he is president, is a joint venture company created to take advantage of the abundance of dinosaur and fossil skeleton material in collections of BHIGR, one of plaintiffs herein, as well as other institutions around the world. (Exhibit 2). He is a harvester of dinosaurs and other fossil species. He takes them from places like South Dakota and sells them throughout the world.

Leitch profits from his association with plaintiffs. The fossils he has received from BHIGR "have been very good." He is "very happy with them." While professing to be objective, he was not. His opinion that the fossil is being subjected to irreparable harm which shortly would be irreversible is simply not true. He has made molds and castings of his purchases from BHIGR and intends to make more. In his view, a completed commercial mold of the Tyrannosaurus rex Sue would be worth \$100,000. The storage of the fossil at other than BHIGR would deny him a business opportunity.

Viewing his demeanor, he remained exactly what he is--a commercial paleontologist--a seeker of antiquities for private commercial purposes. Any scientific interest is second to his commercial interest. The Court discounts his testimony as not credible as relates to the issues to be determined.

Bob Bakker

22. Bob Bakker has been interested in dinosaurs since the fourth grade. He has a masters in paleontology from Yale in 1968, and has done graduate work at Harvard. He has done teaching associated with museums at Harvard and Johns Hopkins University. Since 1983, he has been residing in Colorado. He is on the board of directors of nonprofit corporations and is an adjunct professor at the University of Colorado. He is not a member of the SVP. He acknowledges that in the paleontology society there is some tension in ideas between conservationists and commercial fossil collectors. He expressed his long-held view that commercial collectors were "thieves of time." He still believes that to a large extent, but he has changed his mind as respects plaintiffs' institute because of their treatment of the Tyrannosaurus rex Sue. He became aware of the discovery of Sue in 1990 as a result of a call from BHIGR. He was afforded the opportunity to visit BHIGR. He was alerted as to the seizure and on May 15, 1992, before the seizure was completed, he wrote a letter of protest to Kevin Schieffer, United States Attorney for South Dakota, which is Exhibit 104. The letter was sent not only to the United States Attorney, but also to various paleontologist museums in Alberta; Ottawa; Ontario; Montana; Washington, D.C.; Sichuan, China; Moscow, Russian Republic; Munich, Germany; and 35 addresses in the scholarly community. He sent it to the printed and television media in Boston, Philadelphia,

PAGE 13

New York City, Burbank, California, Washington, D.C. and twenty-five other addresses in the electronic media. Additionally he sent it to the governors of Colorado and South Dakota and the Colorado Senate and House delegations. The Court cites the extent of the distribution of this letter to support its finding that Robert Bakker is a zealot of the first order. This letter and the Court's observations of his demeanor establish to the Court his lacking of credibility on the issues. It is no surprise that this case was reported in the news media all over the world. Plaintiffs and their counsel also have attempted to make this seizure a media event.

Bakker's objection was to the removal of the fossil from circulation. His concern is that the storage of the fossil essentially removes it from the scientific community, and as such, it is his opinion that it should be returned to BHIGR so that it may be made available for educational purposes such as CAT scanning and photographing. He particularly characterizes the condition under which the specimen is currently housed as "dead storage" which is the taking of a fossil where it cannot be repaired by proper conservation measures. He emphatically stated that the only place in the United States which could care for the specimen is BHIGR. Such a statement defies common sense and understanding. He reasons that to delay curation would be scientifically unacceptable. On cross-examination it became apparent that his main concern was to put the fossil back in circulation for curation and restoration.

He noted the presence of trace pyrite on the fossil. He agreed that it would be highly irresponsible to not communicate the existence of pyrite disease to any temporary custodian. He acknowledged the possibility of damage in the event of a move, but would

approve a short distance move to Hill City and BHIGR, recommending the use of a cushioned truck. The approval of a move to Hill City is consistent with his position that BHIGR is the only place in the United States equipped to receive the specimen.

Bakker's objection, and thus his recommendation for a move back to BHIGR, is based upon his underlying feeling that the fossil is now in storage, referred to as "dead storage" and this is scientifically unacceptable, regardless of who may own the fossil. He assumes that a move to BHIGR would permit him access for his purposes.

Michael Patrick Leiggi

23. Michael Patrick Leiggi is the head preparer of paleontology, Museum of the Rockies, Montana State University, Bozeman, Montana. His principal responsibility is to organize and direct field activities for the Museum of the Rockies. It was Leiggi's opinion that the fossil should remain where stored, and that to remove the fossil would raise the real possibility of further damage. He stated that two years would be an acceptable storage period. In examining the storage site, he found that the fossils were carefully packed, stored under a constant temperature, and that it is in its own micro-environment. He found the existence of no pyrite disease and stated that at any rate Andrew Leitch in his opinion was not an expert on pyrite. He stated that Bob Bakker is recognized as a researcher and not a conservator. With respect to Sally Y. Shelton, he stated that she was an expert conservationist. He did not agree with Bob Bakker that "dead storage" will damage the fossil. There is nothing wrong with safe storage and with monitoring at a safe place, but there should be monitoring at least weekly by a conservator or a curator. Leiggi appeared on behalf of the Cheyenne River Sioux Tribe. He has an ongoing application for a permit

to be permitted access to tribal lands of the Cheyenne River Sioux Tribe. He thus was sympathetic to the claim of the Cheyenne River Sioux Tribe as to ownership. While standing alone based upon his interests he could not be considered as an objective expert, nonetheless, his testimony was corroborated by Sally Y. Shelton and Dr. Hunt, both of whom possess independent objectivity.

Leiggi echoed the theme of all witnesses that the more you move and handle, the more there is damage. At SDSM&T he saw no evidence in damage and little cracking on the jackets. He pointed out that there are different preservation techniques and until title was resolved there should be storage without curation or preservation. He stated given the different methods, an owner should make the final decision as to which method should be used in the preparation and curation of the fossil.

Dr. Robert Hunt

24. Robert Hunt, Ph.D. is a vertebrate paleontologist. He is employed by the University of Nebraska as curator of vertebrate paleontology and professor of geology. He stated that most persons who are paleontologists have degrees in biology or geology with specialties in paleontology.

SVP consists of approximately 1,541 members. He is secretary-treasurer of SVP. He expressed his own opinion and the opinion of SVP that there is a strong objection to the removal of the specimen from its present location at SDSM&T to the premises of BHIGR, a commercial fossil-collecting business in Hill City, or to any other locality. (Exhibit 101). He further expressed the concern of thirteen professional vertebrate

paleontologists (including himself) that the specimen should not be moved and that it was not suffering any damage in its present location. (Exhibit 102).

Dr. Hunt stated that the reason for his interest was that it did not seem to him and the other paleontologists that the public outcry over the seizure of the specimen represented the position of the scientific community. He stated that upon inspection he found the fossil was not suffering damage and should not be moved. He was present throughout the court proceedings and listened to the testimony of all the witnesses. He testified there is no compelling reason why research should not proceed under controlled conditions. It was his opinion that BHIGR has not developed an expertise in research.

Dr. Hunt disagreed that BHIGR is the only place in the nation which could house and care for this fossil. He stated there are many major institutions all capable of such storage and conservation. The bones which he observed are no different from any other bones. There exists no condition described as pyrite disease present in the specimens. He testified that there was some pyrite present, but trace pyrite does not mean that the specimen is in danger. He stated further that it is not necessary to look at all the bones; indeed, that to do so would be harmful. Given the low level of pyrite existing, nothing needs to be done except to take care of the fossil. A conservator or curator should be examining the fossil from time to time.

From his demeanor, his objectivity, and his common sense approach to the issues facing the Court, the Court finds Dr. Hunt to be highly credible. He appeared objective and highly professional.

Sally Y. Shelton

25. Sally Y. Shelton is the assistant conservator at Texas Memorial Museum, Austin, Texas, where she manages the Natural History Conservation Laboratory. Her specialty is in conservation and preservation of vertebrate paleontological specimens with particular emphasis on preventative conservation strategies. Her education includes a masters of arts in museum science with thesis at Texas Tech University and a bachelor of science in wildlife and fishery science (museum science option), Texas A & M University. She is responsible for assessing, evaluating, and treating specimens in natural history holdings, including vertebrate paleontology, mineralogy, malacology, recent zoology, and history and ethnography. (Exhibit 109).

She became involved in this matter on a call from the Smithsonian Institution which referred her to the FBI to assist in making an assessment. The conservation assessment was performed on June 5, 1992, and resulted in a conservation assessment report. (Exhibit 8). She filed an affidavit in this case on June 9, 1992, the contents of which were subject to thorough cross-examination by plaintiffs' counsel. (Exhibit 7).

Shelton testified that she relied on the conservation assessment as a guideline (Exhibit 98), particularly the middle section (pages 30-49). By reason of Shelton's close association, her candor, demeanor, and professionalism, the Court renders her testimony highly credible. She was subjected to lengthy and sometimes trivial cross-examination. Her credibility remained untouched.

Shelton updated her examination of the fossil a day or two before the hearing. She conducted tests for biodeterioration, mold, mildew, condition of plaster, pyrite, physical

location, temperature and humidity tests, evaluation of the position of the specimen, and structure location. She stated that at the present time all fossils are in one container, 8' x 8' x 40' in size, located within the building; that the condition of the building is adequate for safe, temporary storage. The fossil is in a steel container and not on the floor. It is not next to any wall. Environmental monitoring steps are proceeding. Temperature and humidity tests have been and are being performed.

She discounted Wolberg's concerns about the rail line as being of no consequence. She said that their museum in Texas is thirty yards from a very active railroad and vibrates to the point that one cannot use a microscope when a train is passing at high speed. She stated that the steel container in which the fossil reposes is properly packed so that any vibration caused by a slow-moving train would have no effect upon the specimen. She stated that any caustic materials are in the boiler room which is in another room and at any rate, the material is inert when stored. There is no rehydration of the plaster covering the portion of the specimen.

During the hearing, upon learning of the charge of "pyrite disease," she notified counsel for BHIGR of her intent to examine for this condition and invited BHIGR to be present. She found no evidence of pyrite contamination. The presence of pyrite is not the same as pyrite oxidation. If there were pyrite disease, that it is a very serious problem. She also stated that if pyrite oxidation had been present and known but not mentioned, it would constitute a breach of ethics. An environment of low humidity (less than 40 percent) and constant temperature will prevent pyrite oxidation. The importance to the treatment and

prevention of pyrite oxidation is to observe and to treat by the use of environmental controls.

Shelton examined the facility at BHIGR. In comparison to SDSM&T she found it more aesthetic, but the functions were roughly equal. Neither had fire suppression, environmental controls, or controls to provide cooling without having the doors open which permit pollution. BHIGR had better monitoring equipment, but it should be read and interpreted in the building it which the fossil is housed and not at a separate station. At BHIGR, the room had a very strong wood odor. Green wood has a high degree of acidity which endangers fossils. Shelton's concern is with handling. Handling has been equated with having a fire, and any more handling would cause damage.

The Court finds that Shelton was a highly credible witness. She exhibited knowledge of the facts, possessed experience and education to interpret those facts, and was fair in her assessment of the competing interests. The reexamination of the fossil after plaintiffs' revelation of the existence of pyrite disease was upon notice to counsel for plaintiffs. Plaintiffs and counsel failed to appear for the reinspection. This indicates to the Court that plaintiffs are not interested in the facts, but rather possession for possession's sake.

26. Of particular importance to the Court on the ultimate issue of temporary custody are the actions taken by plaintiffs' officers upon receipt of rumors that the Federal Bureau of Investigation (FBI) may be investigating the discovery and acquisition of this fossil. Neal Larson, vice president of BHIGR and president of Black Hills Museum of Natural History Foundation, Inc., learned through conversation with some person from the Smithsonian Institution, thought to be Dr. Clayton Ray, that the FBI was inquiring as to the

facts and circumstances surrounding the discovery of the fossil. The contact from the Smithsonian Institution was to Peter Larson, brother of Neal Larson, and president of BHIGR. Neal Larson testified that upon hearing this rumor, he entered the institute and started changing the dates of the discovery on the various boxes from the year 1990 to the year 1991 in order to avoid having to reveal the contents of the changed boxes were in fact a part of the Tyrannosaurus rex discovery. In addition, some records were moved to an outside undisclosed location to avoid a possible search. Locality information was changed. All experts agreed that locality information, that is, the time, date, place, and location of the discovery, is very important to the scientific community. There were apparently about one dozen boxes changed to appear that they did not come off of federal land. Neal Larson agreed further that on the day of the search the computer hard drive somehow crashed. The inference was that it was intentionally "crashed." In justification of his tampering with the evidence, he testified, "I was stupid."

When Peter Larson was examined by government counsel concerning this admission, he said, "Neal did it on his own." "My brother is very emotional and becomes scared easily." He acknowledged further that any change of the records would constitute a violation of the ethics of the paleontology societies, as would a misrepresentation of the actual discovery site of the fossils. During the search, the field notebooks were not found.

This damaging admission of acts which may indeed constitute obstruction of justice completely robs plaintiffs of any credibility that they have to a claim to be temporary custodian of this rare paleontological find.

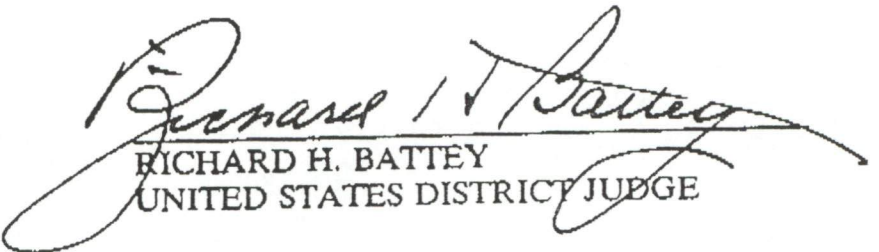
CONCLUSIONS OF LAW

The Court concludes that the only damage occurred to one bone of a large dinosaur. The Court concludes that there has been no irreparable damage to the fossil and that there is no reasonable likelihood that the fossil will suffer irreparable damage in the future.

Based upon the above findings of fact, the Court concludes that the best interest of all parties and the scientific community, including the public at large, will be best served by the continued possession of the fossil with SDSM&T. Appropriate conditions as to its custody await further recommendations from the parties pursuant to this Court's order of July 13, 1992.

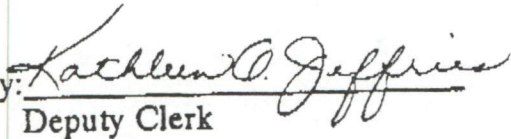
Dated this 16th day of July, 1992.

BY THE COURT:


RICHARD H. BATTEY
UNITED STATES DISTRICT JUDGE

ATTEST:

WILLIAM F. CLAYTON, CLERK

By: 
Deputy Clerk

(SEAL)