January 21, 1979
US Interagency Intelligence Memorandum, 'The 22 September 1979 Event'

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Summary:

Forwarded to Ralph Earle, Director of US Arms Control and Disarmament Agency. The Interagency Intelligence Memorandum on the 22 September 1979 explosion, or Vela Incident, concludes that it was a nuclear explosion.

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THE DIRECTOR OF CENTRAL INTELLIGENCE

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Deputy Director for National Foreign Assessment 21 JAN 1980

NOTE FOR: The Honorable Ralph Earle, II
Director
US Arms Control and Disarmament Agency

Ralph —

The Interagency Intelligence Memorandum, "The 22 September 1979 Event," (attached) was prepared in response to a request of the NSC. Its conclusions rest largely on circumstantial evidence and on the assumption that there was a nuclear explosion on 22 September 1979. (C)

[redacted]

Attachment:
NI IIM 79-10028

[redacted]

[redacted]

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Director of Central Intelligence

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The 22 September 1979 Event

Interagency Intelligence Memorandum

Secret

NI IIM 79-10078
December 1979

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THE 22 SEPTEMBER 1979 EVENT

Information available as of December 1979 was used in the preparation of this memorandum.

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FOREWORD

On the basis of available information, we cannot determine with certainty the nature and origin of the event on 22 September 1979. The conclusions reached in this memorandum rest largely on circumstantial evidence and on the assumption that there was a nuclear explosion. [redacted]

This memorandum was prepared under the auspices of the National Intelligence Officer for Nuclear Proliferation in response to a National Security Council request. It was coordinated at the working level with NFIB representatives in the Interagency Intelligence Working Group on Nuclear Proliferation. [redacted]

KEY JUDGMENTS

DISCUSSION

1. As requested by the National Security Council, this assessment is based on the assumption that the event detected over a portion of the southern hemisphere (see map on page 12) by optical sensors on a Vela satellite at about 0100 GMT on 22 September 1979 was a nuclear explosion. Given the assumption that a nuclear explosion occurred, the purpose of this paper is to estimate what countries may have been responsible for, or involved in, the event. [redacted]

2. Technical information and analyses suggest that:

— An explosion was produced by a nuclear device detonated in the atmosphere near the earth's surface.

— It had a yield equivalent to less than 3 kilotons.

— It took place within a broad area, primarily oceans, that was generally cloudy.[1] [redacted]

3. Various types of nuclear devices could have yielded the equivalent of less than 3 kilotons of high explosive. Such yields could have been obtained either by careful design of a weapon with that yield, through intentional reduction of yield of a higher yield device, or by partial failure of a higher yield device. In practical terms, the testing of a nuclear device at sea would not have needed to involve more than two or three ships or aircraft, including several dozen crewmen and technicians. Equipped with appropriate diagnostic instruments, they could have set up the test within a few hours, detonated the device, obtained required data within minutes after the explosion, and dispersed within another few hours. [redacted]

4. In addition to the five countries that are acknowledged nuclear weapon states, we believe that there are five other states that have in the 1970s designed devices suitable for nuclear testing. Of these, we believe that only Israel, India, and South Africa have recently had the fissile material as well as the other components needed to fabricate nuclear explosive devices. In contrast, Pakistan and Taiwan have probably lacked sufficient fissile material for even a single nuclear explosive device. Several advanced non-nuclear-weapon states, such as West Germany, have possessed both the materials and the technical expertise; none of them, however, has had an incentive, on balance, to develop nuclear weapons, much less to test a device. Other states that might have nuclear ambitions—such as Brazil, Argentina, and Iraq—almost certainly lacked the fissile material and nonfissile components required to fabricate and test nuclear explosive devices. Neither France nor China has agreed to refrain from testing in the atmosphere, but they have recently had no known technical or political motivation to test clandestinely in the southern Indian or Atlantic Ocean. The Soviet Union would have had to assume inordinate political risks in its relations with the United States to have conducted a covert nuclear explosion in violation of the Limited Test Ban Treaty (LTBT) for any purpose. [redacted]

5. The Defense Intelligence Agency believes, however, that if an atmospheric test were in the technical interest of the USSR, an anonymous test near an unwitting proxy state such as South Africa could have provided an attractive evasion method. The Department of Energy believes that, while the Soviets have had the capability to test clandestinely, they have recently had no technical reason or motivation to do so. The Department further speculates that such a test could have been seen as serving Soviet political interests by disrupting peace efforts and further polarizing moderate elements in southern Africa. [redacted]

6. An unintended firing and near-surface detonation of a nuclear weapon during a military exercise could also have produced the signals that were detected.[2] The multiple safety measures that would have had to be negated, however, and the absence of any known weapons carriers in the area on 22 September would have made such an event quite unlikely. The explosion of a nuclear weapon aboard a weapons carrier would have been even less likely, because the yield of an accidental detonation almost certainly would not have been sufficient to produce the detected signals. Moreover, no nuclear weapons carriers are known to have been missing and no associated

[1] See page 13 for an assessment by the Joint Atomic Energy Intelligence Committee of all technical information received and analyses performed to date. [redacted]

[2] The possibility raised in public speculations that a reactor accident might have caused the signals that were detected can be completely ruled out on technical grounds. [redacted]

[redacted]

search-and-rescue operations have been noted. Finally it is very unlikely that any known subnational entity could have conducted a nuclear explosion or would have been motivated to do so.[9] So the following assessment considers the capabilities and motivations of only those five "non-nuclear-weapon states" that might have attempted to test secretly in a remote ocean area of the southern hemisphere during September 1979. [redacted]

A Secret Test by South Africa

[redacted]

8. In late 1977 the Vorster government apparently suspended preparations to test. Strong US pressure and other international reactions appeared to have deflected South Africa at least temporarily from testing. The setback probably compelled Vorster and the key officials in the nuclear weapons program to review their whole approach toward weapons development and testing. Statements made by the Vorster government at that time did not permanently foreclose future options for testing. Rather than completely stopping their weapons program, the South Africans could then have decided to prepare for a future nuclear test more securely. In any case nuclear testing was almost certainly not feasible until late 1978 at the earliest, when sufficient quantities of highly enriched uranium could have been expected to become available. In short, the Vorster administration may well have deferred any decisions on whether or when to test. [redacted]

setback @ 77 test

9. ***Botha's Policy.*** Arguments that nuclear testing could make an important contribution to technical confidence in and, to the extent it was disclosed, foreign respect for South Africa's military strength in all likelihood would have resonated with Prime Minister Botha and other South African officials. Botha had overseen a substantial buildup of South Africa's defense forces in the late 1960s and 1970s, following a decision in the early 1960s to achieve self-sufficiency in arms. Because of his personal convictions as well as his official responsibilities, he has advocated more than any other Cabinet officer the military components of South Africa's strategy for coping with possible external threats. He has regarded the West as unwilling to support South Africa against foreign threats that he has perceived to be growing. Moreover, he has probably sympathized with views that nuclear weapons might ultimately be needed. However, he probably has not foreseen any imminent military requirement for nuclear weapons or any political advantages to disclosing particular elements of South Africa's nuclear weapons capabilities at this time. Nevertheless, he may have been persuaded that undeclared but undenied nuclear weapons would have an important psychological deterrent effect that South Africa could better achieve through testing. [redacted]

SA doesn't want to disclose

[redacted]

11. If P. W. Botha had decided in favor of a nuclear test, he would have evaluated alternative options for conducting it in terms of their expected effectiveness, risks, and costs. To minimize adverse foreign reactions, he would have had to assess both the chances and the consequences of discovery. While an atmospheric test over unfrequented international waters presumably would have been seen to entail some risk of being found in violation of the Limited Test Ban Treaty, to which South Africa is a party, it also would have offered a relatively quick, safe, and easy way for South African weapons designers to prove a nuclear device without creating unambiguous evidence that South Africa was responsible for a nuclear explosion. In contrast, an atmospheric or underground test in South Africa probably would have entailed higher risks of

[9] See SNIE 6-78, *Likelihood of Attempted Acquisition of Nuclear Weapons or Materials by Foreign Terrorist Groups for Use Against the United States* (especially the section on "Acquisition and Exploitation of Nuclear Weapons"), 12 December 1978. [redacted]

prior detection and ultimate proof by foreign intelligence because it probably would have required site preparations and left tangible indications of a nuclear explosion. Botha's security advisers might have warned him that, if South Africa were discovered to have violated the LTBT, it might suffer more serious sanctions than if it tested underground. On the other hand, they would have raised the possibility of another international uproar and more serious threats if new underground test preparations were detected, and the likelihood of more serious sanctions if South Africa proceeded to test under such circumstances. Thus, Botha probably would have decided to minimize the risks of prior detection and certain attribution by testing secretly at sea rather than within South Africa.

12. As Defense Minister since 1966, P. W. Botha very likely supported the development of a nuclear weapons program, including military preparations for nuclear testing. As Prime Minister, Botha has retained the Defense portfolio and has continued to keep closer counsel with senior military officers than with other government officials. We have no specific evidence that senior military officers perceive any imminent, or an eventually important, role for nuclear weapons.

[redacted]

18. In September 1979 some special security measures were put into effect which indicate that certain elements of the South African Navy were exercising or on alert on 22 September. The harbor and naval base at Simonstown were declared, in a public announcement on 23 August, to be off limits for the period 17-23 September. The US defense attache gathered from several reliable sources that harbor defense exercises took place there during this period.[a] Although such a closure might not be required for a nuclear test at sea, it could have screened sensitive loading or unloading operations as well as ship movements. Also, the Saldanha naval facility, which includes a naval search-and-rescue unit, was suddenly placed on alert for the period 21-23 September. The alert was not publicly announced, no explanation for it was given to naval personnel, and no activity was observed in or around the port. While the Saldanha naval alert appears unusual, we are unable to state with confidence whether such an alert has ever happened before. Furthermore, at the same time, General Malan, Chief of South Africa's Defense Force, was reported to be touring South America, when he might have been expected to be in South Africa or at the test observation point during such an important event. [redacted]

19. Prime Minister Botha has avoided public comment on the issue since the US disclosure of the Vela indications. However, on 25 September—three days after the nuclear event—he told a provincial congress of the ruling National Party that "South Africa's enemies might find out we have military weapons they do not know about." His enigmatic remark prompted speculation in the South African press that he had undeclared nuclear weapons in mind. [redacted]

[redacted]

20. On 24 October—before the US disclosures of the technical indications of a test—the Prime Minister, addressing an anniversary dinner attended by past and present members of the AEB as well as members of the local diplomatic corps, reportedly paid tribute to the South African nuclear scientists who had been engaged in secret work of a strategic nature. He reportedly said that, for security reasons, their names could not be mentioned and that they would never gain the recognition in South Africa or abroad that they deserved.[b] [redacted]

21. ***South African Responses to Nuclear Test Allegations.*** South African official commentary since the United States disclosed the Vela indications of a nuclear event have been consistent with Pretoria's longstanding practice of cloaking its nuclear intentions in ambiguity—intimating a weapons capability without saying anything that would prove a case for tightening international sanctions against South Africa. [redacted]

22. Only one official has categorically denied South Africa's involvement. On 26 October, immediately following the announcement in Washington of the Vela indications, Jacobus de Villiers, President of South Africa's Atomic Energy Board, told the press, "If there was anything of the sort, my first reaction would be that some other power might have undertaken a test, but it was definitely not South Africa." De Villiers, who had been directly involved in weapons design work at the Pelindaba nuclear research center before his promotion to President of the AEB in July 1979, almost certainly would be witting if South Africa had conducted a test explosion—and prepared to parry press queries if such a test were detected. On 6 November, De Villiers issued a report of periodic atmospheric samplings that had been conducted by the AEB; the report concluded, "It is considered most unlikely that an atmospheric nuclear test has recently been conducted in this region." [redacted]

23. On 25 October the Commander of the South African Navy made allegations we believe to be false

[a] The US defense attache's report played down the significance of the Simonstown closure, noting that it was a regular practice linked to internal defense. [redacted]

[redacted]

that a Soviet nuclear submarine had been in the vicinity of the Cape in late September, implicitly denying that the South African Navy was involved in a nuclear test conducted at sea. [redacted]

24. Foreign Minister Roelof Botha's public statements have been especially ambiguous. For instance, on 25 October he ridiculed speculation that South Africa had conducted a nuclear explosion, but also declined under questioning to say unequivocally that South Africa had not done so and that it did not intend to acquire nuclear weapons. On 6 November the Foreign Minister, in a discourse on South Africa's foreign policy presented to all the foreign ambassadors in Pretoria, said he was dismayed by allegations in the UN General Assembly that South Africa had violated the Limited Test Ban Treaty, and distributed the AEB report on atmospheric samplings as evidence to the contrary. But he did not take the opportunity to deny that South Africa had a nuclear weapons program. [redacted]

A Secret Test by Israel

[redacted]

[redacted] Beyond this, the Israelis might have conceivably foreseen needs for more advanced weapons, such as low-yield nuclear weapons that could be used on the battlefield. Or they might have considered desirable a small tactical nuclear warhead for Israel's short-range Lance surface-to-surface missiles. Israeli strategists might even have been interested in developing the fission trigger for a thermonuclear weapon. If they were to have developed reliable nuclear devices for any of these weapons without access to tested designs, moreover, Israeli nuclear weapons designers would probably have wanted to test prototypes. A low-yield nuclear test conducted clandestinely at sea could have enabled them to make basic measurements of the device's performance. [redacted]

27. However, Israeli authorities could not have ignored inevitable security risks. The dangers of being discovered would have posed for them serious liabilities, particularly an adverse US reaction, which could damage the special relationship between Tel Aviv and Washington. The Israelis also would have had to take account of possible Soviet reactions, including stepped-up military assistance to Arab states, the likelihood of serious damage to the peace treaty with Egypt, and an erosion of support among traditionally friendly West European states. The Department of Energy believes that for Israel to explode a device off South Africa's shore and allow South Africa to take the blame is not consistent with Israel's policy or attitude toward Pretoria. [redacted]

28. In short, Israel may well have had requirements to test that have been in conflict with its basic policy of avoiding any overt demonstration of a nuclear capability. We believe this policy has been very important to Israel, and we doubt that its incentives to test would have been sufficient to overcome its disincentives as long as the leadership perceived any substantial probability of unambiguous attribution to Israel. However, this consideration would not have ruled out the possibility of a clandestine test conducted in a remote ocean area. Indeed, of all the countries which might have been responsible for the 22 September event, Israel would probably have been the only one for which a clandestine approach would have been virtually its only option. [redacted]

[redacted]

[redacted]

A Secret Test by South Africa and Israel

29. If the South Africans had considered testing Israeli designs in exchange for Israeli technical assistance, the benefits of cooperation would have been carefully weighed by both parties against the security risks inherent in such joint operations. On the one hand, the Israelis would have calculated that South Africa, as a pariah state in need of reliable friends, would have had every reason to preserve security and to remain silent in the face of inevitable speculation about its complicity with Tel Aviv. The Israelis also could have counted as a high probability that responsibility for any nuclear test in the area under investigation would be attributed to South Africa. On the other hand, unless the Israelis had offered advanced weapons technology, South African weapons developers would probably have preferred to test their own design before incurring security risks in testing a foreign design. The Defense Intelligence Agency believes that South Africa would probably have had enough confidence in Israeli security to consider conducting a joint test. [redacted]

30. Israelis have not only participated in certain South African nuclear research activities over the last few years, but they have also offered and transferred various sorts of advanced nonnuclear weapons technology to South Africa. So clandestine arrangements between South Africa and Israel for joint testing operations might have been negotiable. [redacted]

[redacted]

[redacted]

38. The purposes in conducting a test at sea under cover of clouds and darkness would have been to maximize pretest security and to reduce the presumed risks of detection, attribution, and sanctions by foreign powers. [redacted]

39. The Bureau of Intelligence and Research, Department of State, believes that, while South Africa is in all probability embarked on a nuclear weapons program, has by this time acquired sufficient fissile material for the fabrication of several nuclear devices, and may be willing to take the risks of testing eventually, there are sufficient political motivations to deter the Botha government from undue provocation of international criticism at this time. The arguments which the United States and other Western powers advanced to deter South Africa from proceeding with construction operations at the Kalahari site are still valid: unless South Africa is willing to relinquish a clandestine as well as overt nuclear weapons option, its access to Western technology and uranium enrichment services might be terminated. [redacted]

40. State/INR differs particularly with the premise that Prime Minister Botha's government has been more ready than its predecessors to develop nuclear weapons. It points out that all South African governments have sought this option, but that until recently South Africa lacked the relevant technology and fissile material. Even now, the political constraints would outweigh technical incentives in South Africa's calculations, and therefore it is unlikely that South Africa elected to test a nuclear device. The ambiguity that surrounds South Africa's nuclear situation has provided it with substantially the same benefits—without the opprobrium—as if it had in fact tested. Elusiveness serves South Africa best at this juncture, and is in line with its previous behavior—neither to confirm nor to deny allegations about its nuclear-weapons-related activities. [redacted]

ambiguity as good as a test

41. In sum, State/INR finds the arguments that South Africa conducted a nuclear test on 22 September inconclusive, even though, if a nuclear explosion occurred on that date, South Africa is the most likely candidate for responsibility. [redacted]

42. The Defense Intelligence Agency believes that the available evidence is insufficient to estimate how top South African officials have balanced the incentives and disincentives regarding a nuclear test. [redacted]

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May 23, 1980 (13C)

AD HOC PANEL REPORT ON THE SEPTEMBER 22 EVENT

Background

A panel of nongovernment scientists (listed in appendix) was convened by Dr. Frank Press, Science Adviser to the President and Director of the Office of Science and Technology Policy, to assist in determining the likelihood that the light signal recorded by a VELA satellite over the South Atlantic on September 22, 1979, was from a nuclear explosion. Specifically, the panel was asked to (1) review all available data from both classified and unclassified sources that could help corroborate that the VELA signal originated from a nuclear explosion and suggest any additional sources of data that might be helpful in this regard; (2) evaluate the possibility that the signal in question was a "false alarm" resulting from technical malfunction such as interference from other electrical components on the VELA platform; and (3) investigate the possibility that the signal recorded by our VELA satellite was of natural origin, possibly resulting from the coincidence of two or more natural phenomena and attempt to establish quantitative limits on the probability of such an occurrence.

The panel met three times; the last meeting was April 2-3, 1980. During the course of its work the panel (1) received numerous briefings by the Air Force Technical Applications Center (AFTAC)--the government agency responsible for detecting non-U.S. nuclear explosions and collecting and analyzing data from such explosions--and was particularly impressed with the analyses provided by AFTAC; (2) studied performance data, circuitry and hardware involved in the VELA satellite program; (3) initiated and reviewed results of statistical analyses of the hundreds of thousands of light signals that have been recorded previously by VELA satellites and of computer modeling of natural phenomena that might have generated the September 22 signal; (4) reviewed all available data that might tend to corroborate whether that signal was generated by a nuclear explosion; and (5) reviewed analyses made by government agencies that bore on the question of whether the September 22 signal was of nuclear origin. In addition a subgroup of the panel was briefed on available nontechnical intelligence that related to the September 22 event.

The Office of Science and Technology Policy (OSTP) also requested the Naval Research Laboratory to search worldwide for geophysical data that might bear on the origin of the September 22 event and do independent analyses of this data. NRL has not yet completed its task but has briefed the panel at its third meeting on its findings to date.

~~Review on May 23, 1986~~
Declassify on: OADR

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Partially Declassified/Released on 4-25
under provisions of E.O. 12958
by D. Van Tassel, National Security Council
F87-88

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Summary of Conclusions

At its third meeting, the panel reviewed the most recently collected data and analyses. Its findings and conclusions are summarized as follows:

1. The light signal from the September 22 event strongly resembles those previously observed from nuclear explosions, but it was different from the others in a very significant way. The discrepancy suggests that the origin of the signal was close to the satellite rather than near the surface of the earth. In order to account for the September 22 VELA signal as coming from a nuclear explosion, one must hypothesize particularly anomalous functioning of the instruments (bhangmeters) that observed the event.

2. The bhangmeters on the VELA satellites have been triggered by and have recorded almost all previous nuclear explosions. They have also recorded hundreds of thousands of other signals, mostly from lightning and cosmic ray particles striking the light sensors. In addition they have been triggered several hundred times by signals of unknown origin, "zoo events." A few of these zoo events had some of the characteristics associated with signals from nuclear explosions, although they could be distinguished clearly from nuclear explosion signals upon examination of their complete time histories.

3. The search for nuclear debris and for geophysical evidence that might support the hypothesis that a nuclear explosion was the source of the September 22 event has so far only produced data that is ambiguous and "noisy." At this date, there is no persuasive evidence to corroborate the occurrence of a nuclear explosion on September 22.

4. Based on the lack of persuasive corroborative evidence, the existence of other unexplained zoo events which have some of the characteristics of signals from nuclear explosions, and the discrepancies observed in the September 22 signal, the panel concludes that the signal was probably not from a nuclear explosion. Although we cannot rule out the possibility that this signal was of nuclear origin, the panel considers it more likely that the signal was one of the zoo events, possibly a consequence of the impact of a small meteroid on the satellite.

Observed Bhangmeter Signals

Each VELA satellite carries two bhangmeters--devices that observe incident light and trigger a recording apparatus when light intensity changes rapidly. The two bhangmeters have different sensitivities so that a wide range of light intensities can be observed and recorded.

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[redacted] 1.5(c) (d) Overall, the VELA bhangmeters have been triggered hundreds of thousands of times, mostly by light from lightning and energetic cosmic particles both of which have identifiable short time duration signals. The bhangmeters have also been triggered by calibration signals from internal light sources or, recently, ground based lasers, direct sunlight and "other" sources (referred to as zoo events) which are not satisfactorily understood and which have great variation in signal character.

It had been thought that the zoo events were due to passing meteoroids, but we have not been able to construct a satisfactory model to justify this explanation. More recently an explanation has been offered that these signals are from sun reflection from debris ejected from the satellite after a collision with a small meteoroid. This explanation seems more plausible to the panel but has yet to be fully developed.

Figures 1-5 shows some bhangmeter records from different events:

- Figure 1 shows a typical short duration signal identified as lightning.
- Figure 2 shows a typical low-yield nuclear explosion with its characteristic double-hump.
- Figure 3 shows the optical signature recorded by both the more sensitive (YC) and the less sensitive (YV) bhangmeter of the September 22 event.
- Figure 4 shows an example of one of the few zoo events in which a double-humped optical pulse is observed. However the detailed pulse shape is not consistent with what is observed from a nuclear explosion.
- Figure 5 shows an example of a long duration zoo signal which is obviously very different from a nuclear explosion signal.

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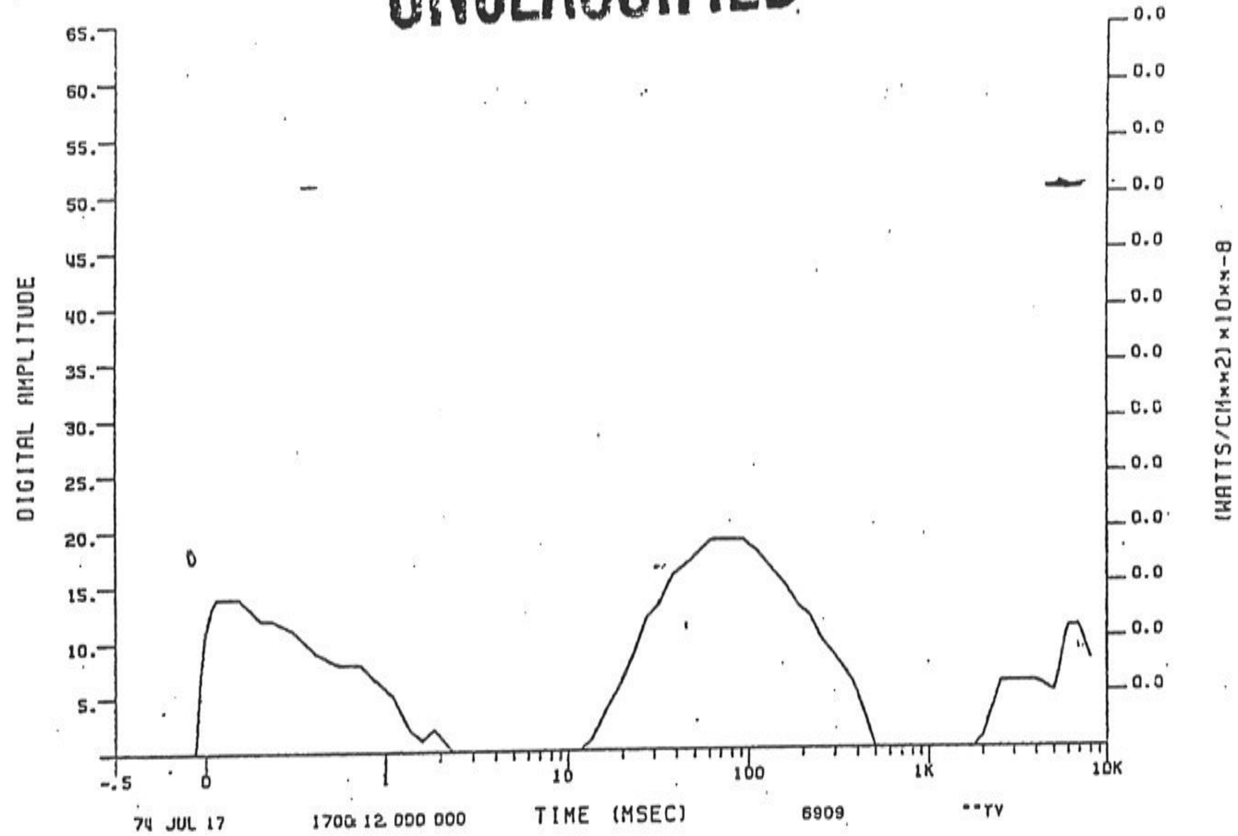
FIGURE 2



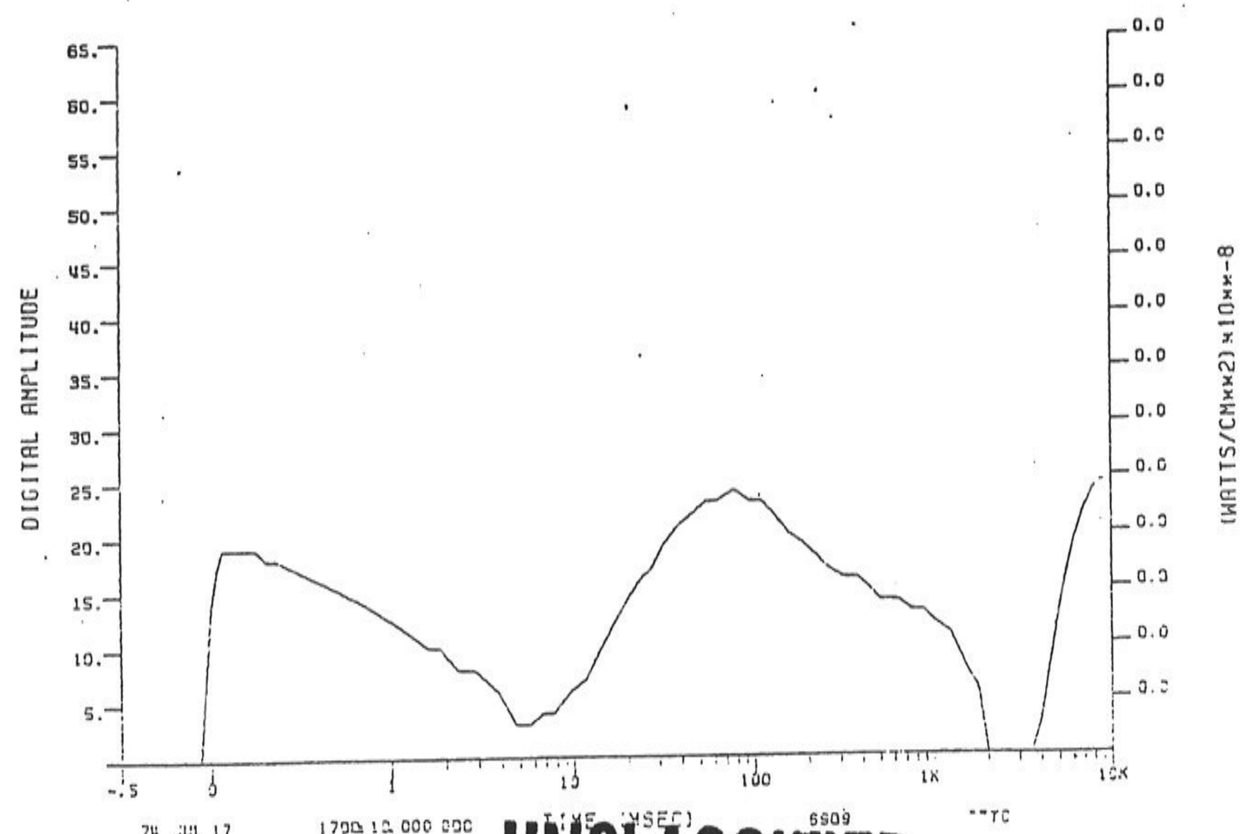


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FIGURE 3

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FIGURE 4

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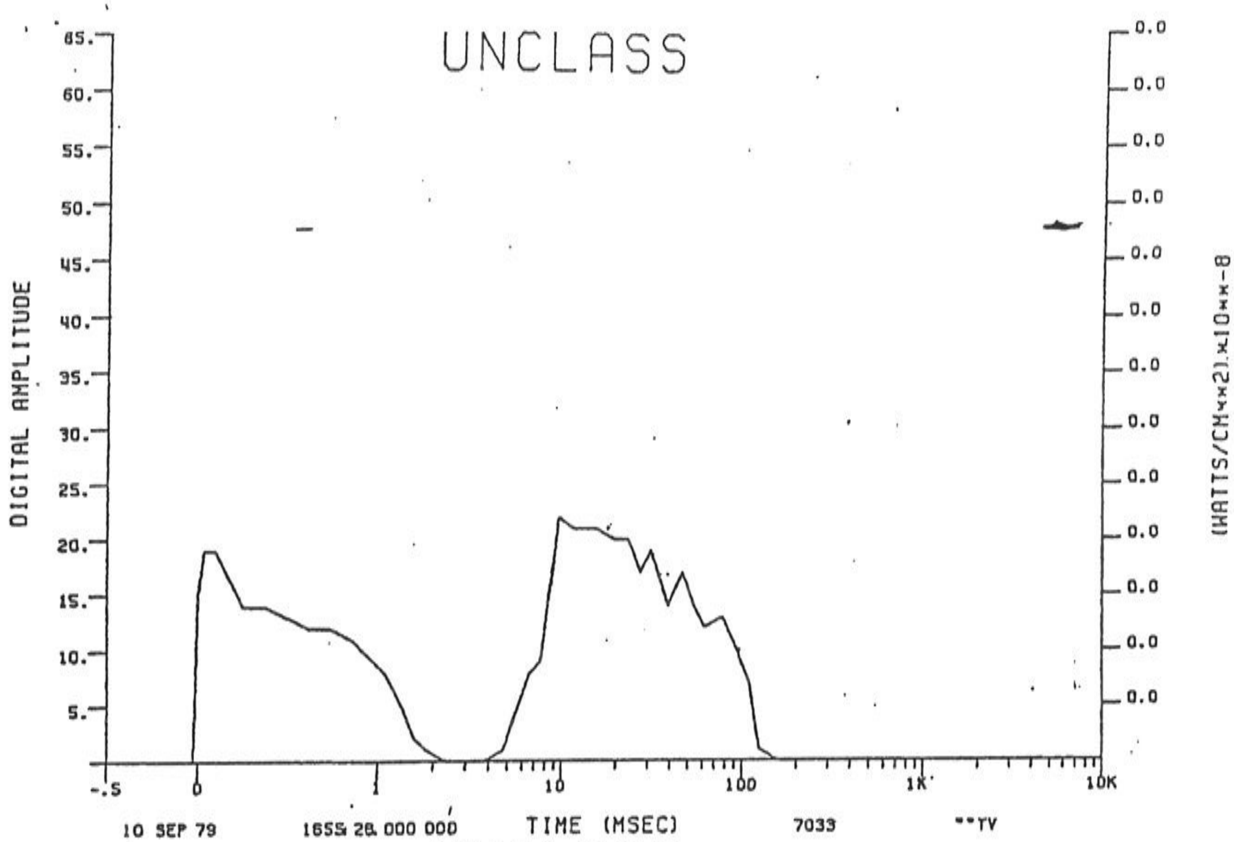

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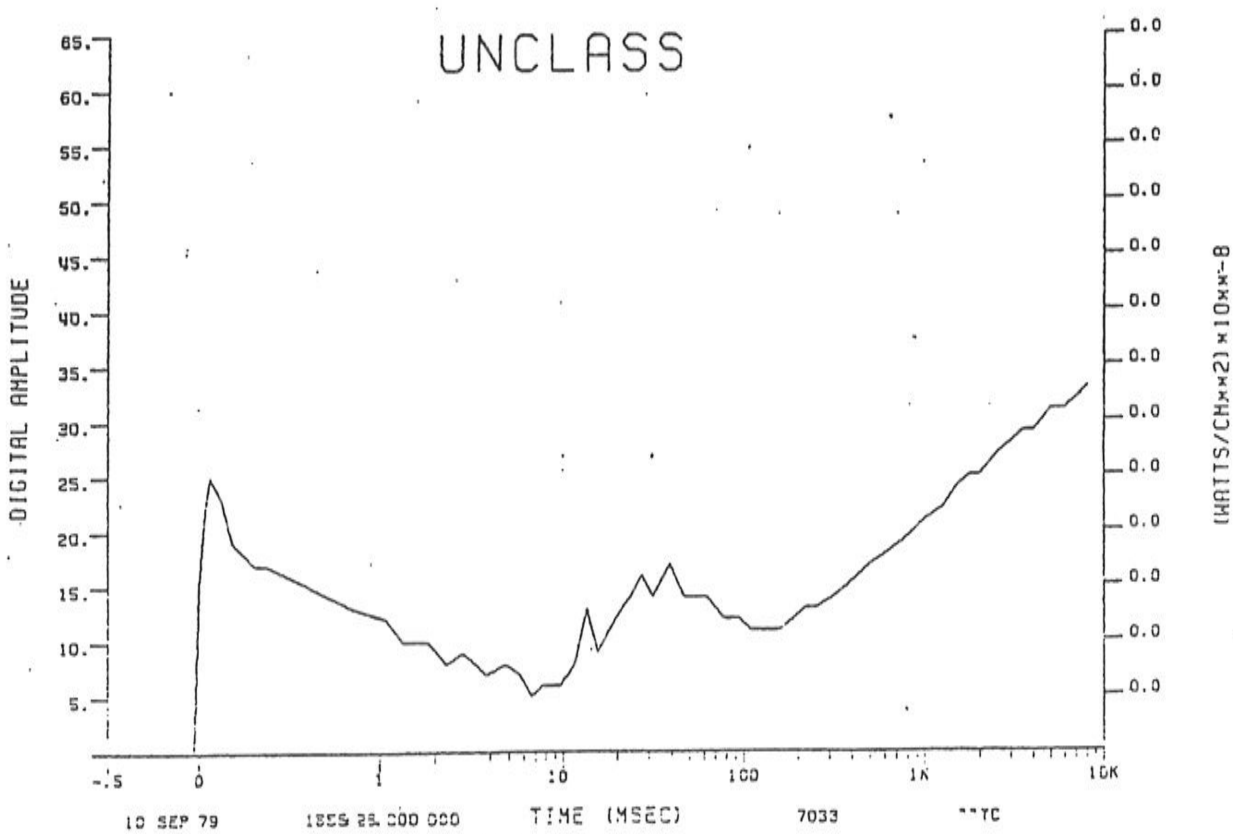

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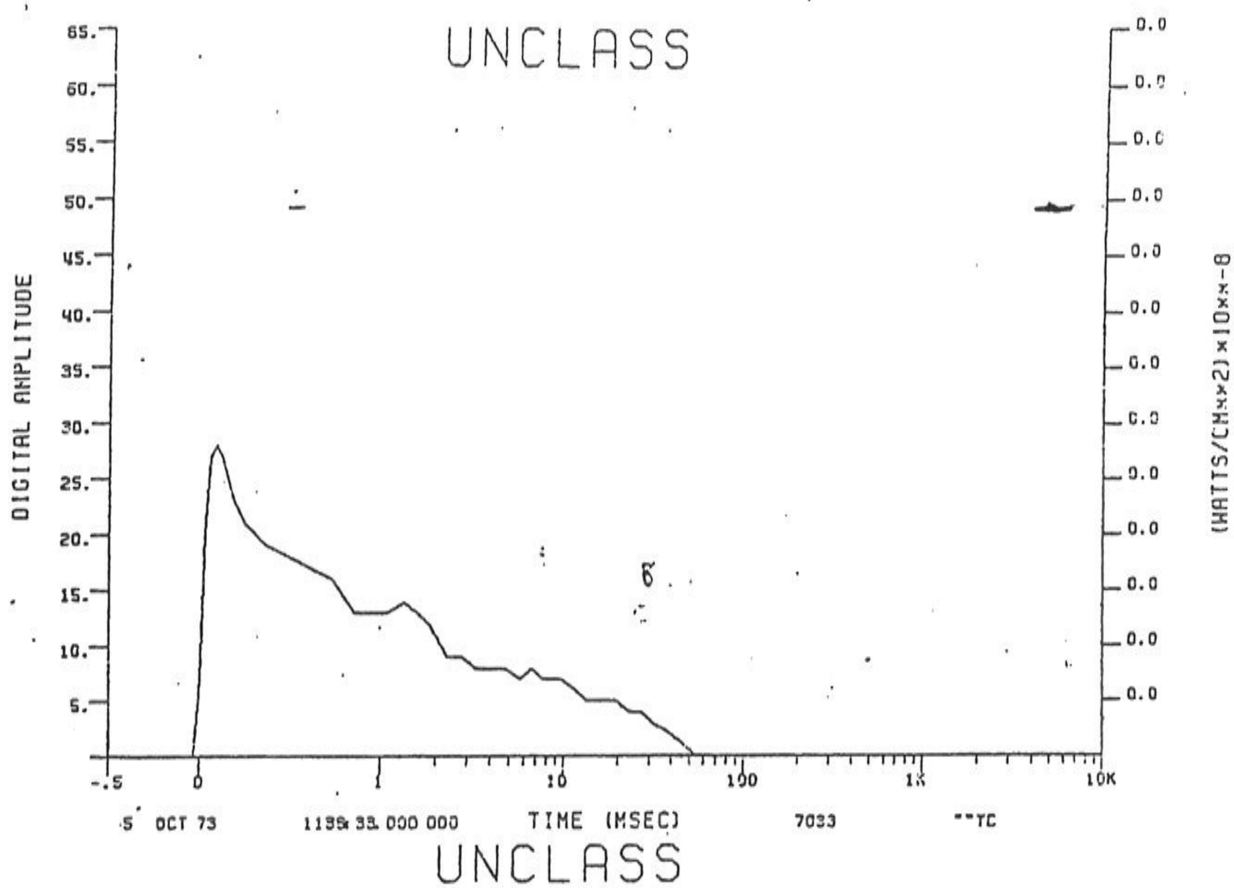
FIGURE 5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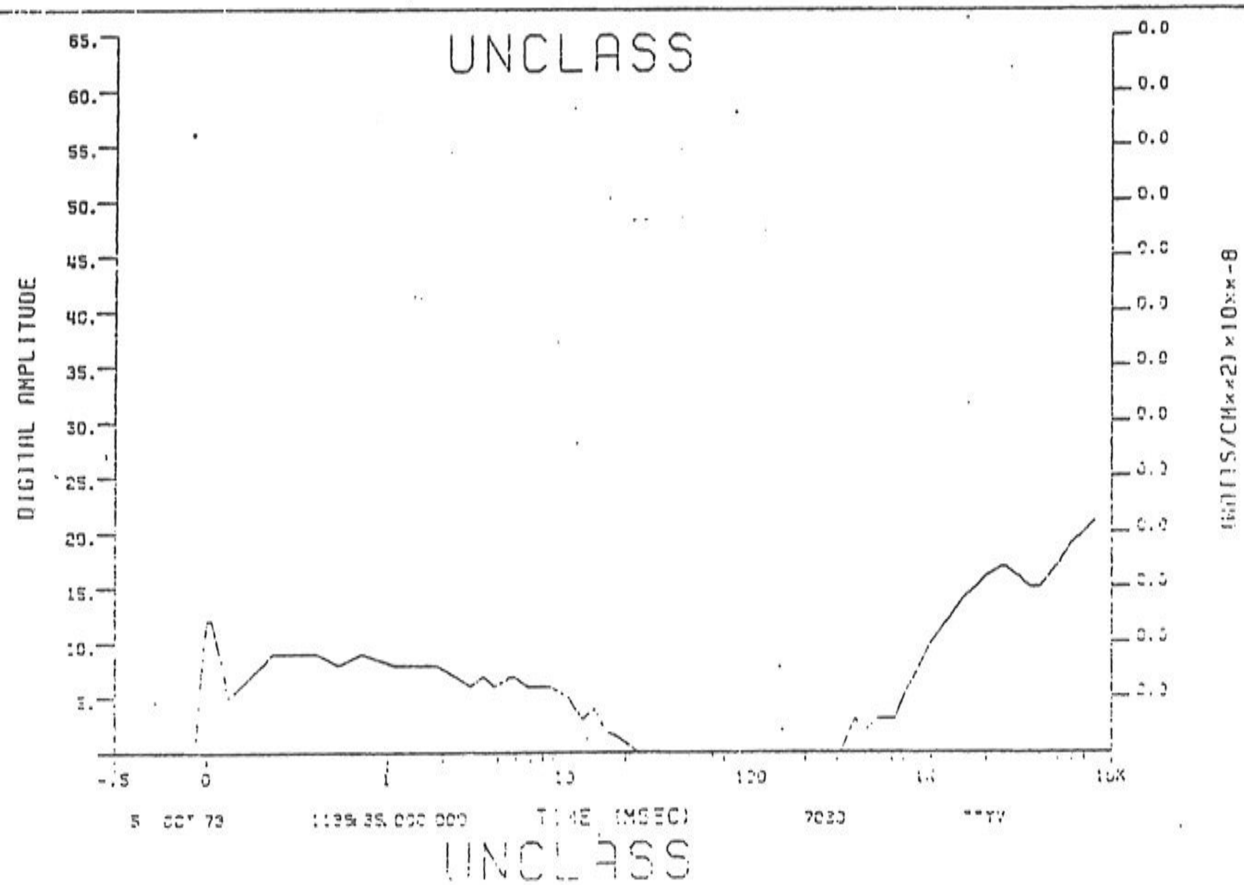
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FIGURE 1

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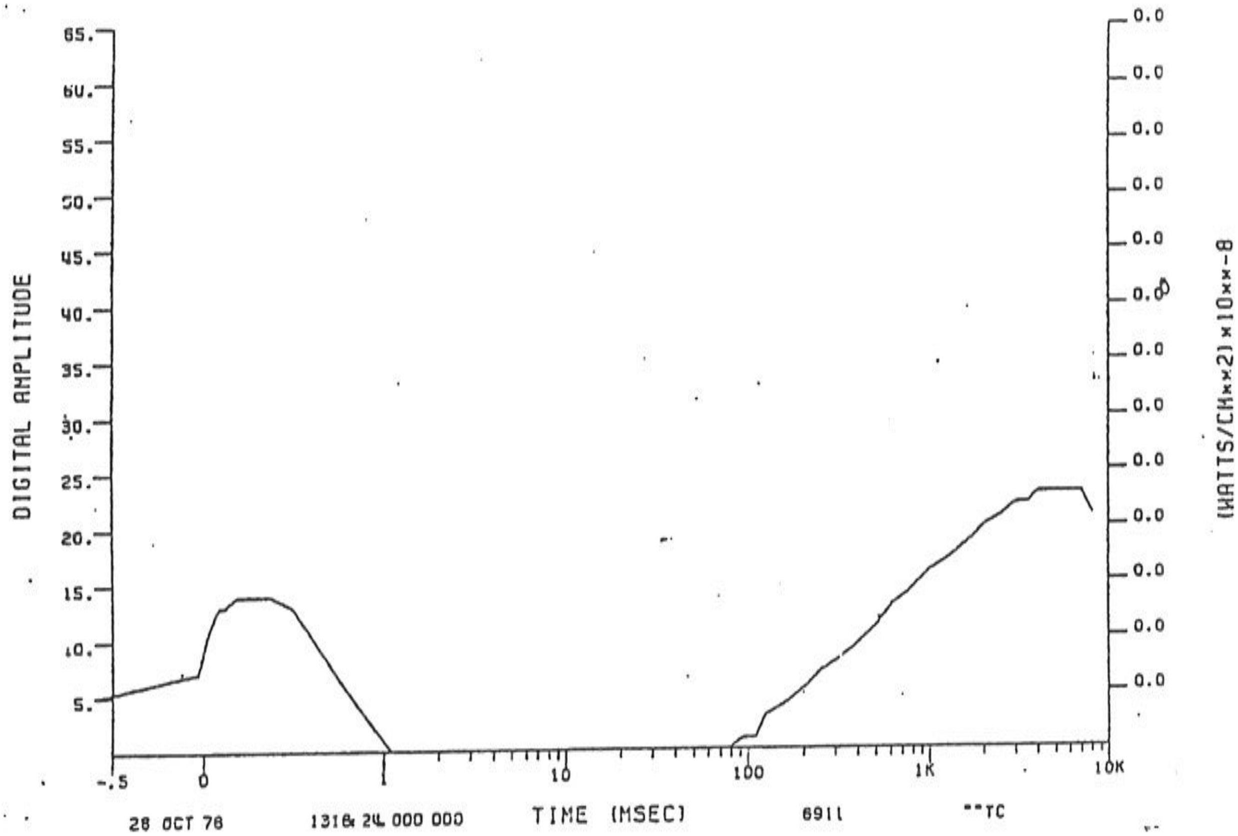

The September 22 Event

On September 22, 1979, the two "bhangmeters" on board a VELA satellite observed a flash of light consistent with that observed from a nuclear explosion on or near the earth's surface. Identical or very similar bhangmeters are also on board other VELA and DSP satellites. However, these other satellites were looking at different parts of the earth and due to weather conditions had very little coverage overlap on the surface of the earth with the VELA satellite that observed the light flash. None of these others observed the light signal that was recorded by these bhangmeters.

The September 22 event has many of the features of signals from previously observed nuclear explosions. It has the right duration and the characteristic double-humped shape was recorded by both bhangmeters. The three separate yield determinations, which are normally derived from the time of the maximum and minimum of the pulse shape, are in rough agreement. (They agree about as well as one might expect, given experience with past low-yield events.) These results and the signal characteristics are consistent with a determination that the September 22 signal was from a nuclear explosion. But in making such a determination it is also necessary to show that the signal has no additional characteristics that rule out the nuclear origin hypothesis, or that there is not another class of signals for which it is more likely that the one of September 22 is a member.

It is interesting to note that the total light intensity observed on September 22 was considerably larger than expected for a hypothesized explosion with this measured yield. This could only be explained if the signal had been transmitted through "clear skies"--e.g., if the region where the signal originated was essentially cloud free. Yet heavy cloud cover and local rainout seem necessary to explain the absence of nuclear debris. However, these facts could be reconciled if the light were transmitted through a small local gap in cloud cover.

But more important, careful examination reveals a significant deviation in the light signature of the September 22 event that throws doubt on its interpretation as a nuclear event. The deviation is seen in the examination of the relative intensity of signals recorded in the two bhangmeters YC and YV. While the ratio of light recorded by YC and YV is not necessarily constant, it is expected to be reproducible, i.e., if at one time the bhangmeters recorded YC = 20, YV = 10 on a linear scale, then at a later time if YC = 20 again, one expects to see YV = 10 again, although YC may not be twice YV for other values. A "scatter plot" in which amplitude readings for the two bhangmeters are plotted against each other, should show a narrow locus for the recorded signals.

Actual data recorded for ground-based events does not completely conform to these ideal characteristics because of time differences between triggering of the two channels and changes in background (termed "tailup" and "taildown") during data recording.

Figure 6 shows YC versus YV plots for twelve known nuclear events and the September 22 event, all recorded by the VELA satellite that observed the September 22 event. To obtain this plot small time-shift corrections to the original data have been made to compensate for the fact that the two bhangmeters operate independently and do not trigger at precisely the same time. In addition, each time history has been truncated at the onset of tailup or taildown effects.

In the resulting plot, the discrepant behavior of the September 22 event in relation to known nuclear events is evident. All of the nuclear events fall within a narrow band, but the second hump of the September 22 event causes it to fall distinctly outside the nuclear band. Qualitatively, this means that during the second hump, the ratio of the bhangmeter signals is significantly different from what would be expected from a nuclear explosion near the surface of the earth. Such anomolous behavior was never observed in bhangmeter recordings of previous nuclear explosions. Thus, although the September 22 event displays many of the characteristics of nuclear signals, it departs in an essential feature.

It is very difficult to account for such a departure if the source of the September 22 signal was at a great distance from the bhangmeters, i.e., on the surface of the earth. On the other hand if the source of the September 22 signal were close to the satellite sensors, the relative intensity of the light incident on the two bhangmeters could be quite different from cases where the source is far away. That is, an object passing near the satellite might be more in the field of view of one sensor than the other, whereas at a distance the field of view of both sensors is essentially the same.

If the September 22 event were a zoo member rather than a nuclear explosion, then the deviation from the nuclear signal region in the YC/YV scatter-plot is not surprising. Many zoo events show large deviations in the scatter plot. Figure 7 illustrates this deviation for the zoo event in figure 8.

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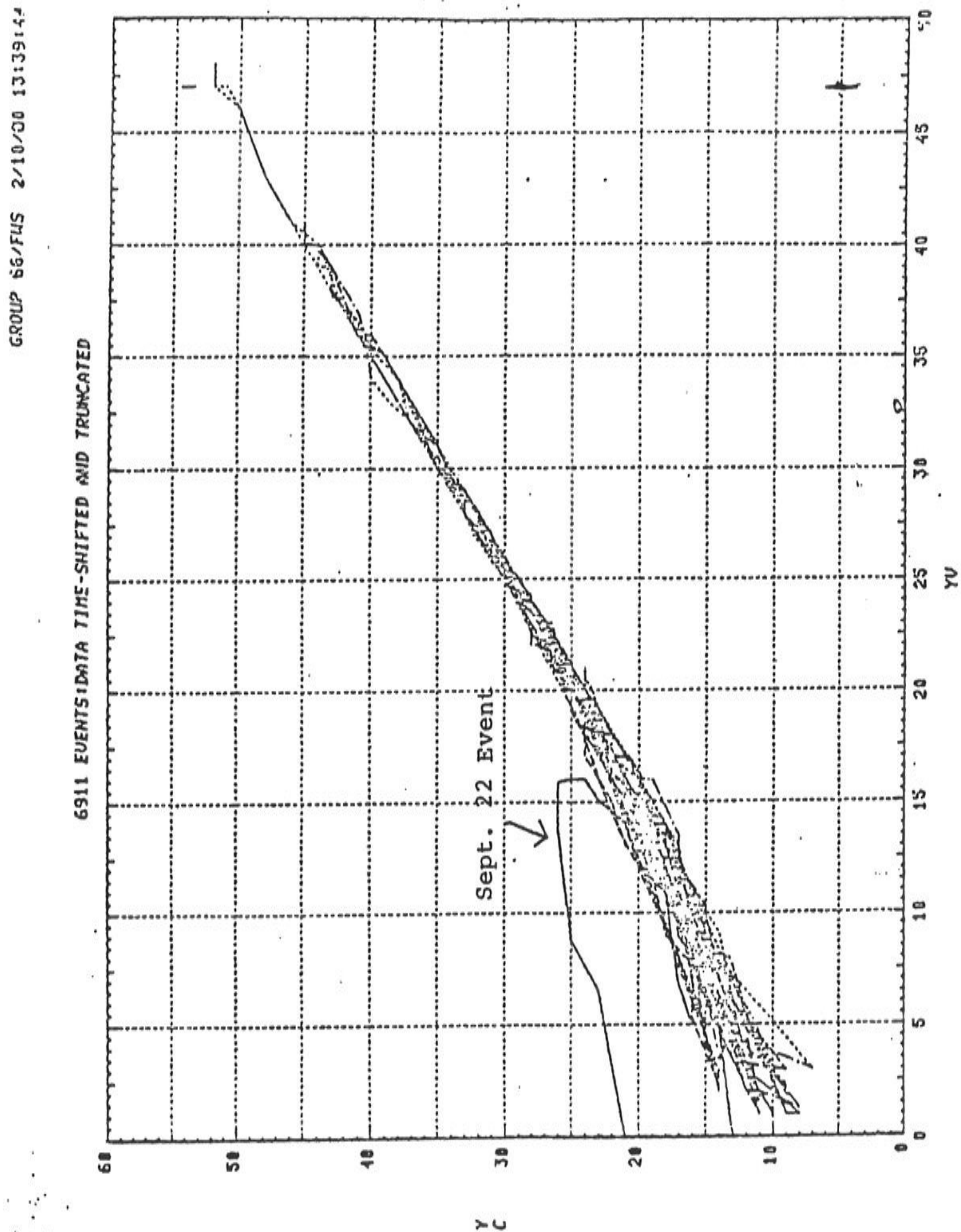
FIGURE 6



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PAGE 12

- FIGURE 7 -

1.5 (g)

PAGE 13

- FIGURE 8 -

1.5 (g)

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These deviations are explainable by light reflections from material sufficiently close to the bhangmeter (within about 30 meters) so as to be out of the primary field-of-view of one or both of the optical sensors. In fact the obvious discrepancy between the two bhangmeter signals was responsible for these events once being labelled "meteoroids." It is impossible to make the zoo events lie in the narrow range seen for earth-based signals (such as the known nuclear events shown in figure 6) by adjusting the time delay between the YC and the YV channels.

In light of the consistency of all known nuclear event data when presented in YC/YV parameter space, the discrepant behavior of the September 22 event assumes major significance. If it is a nuclear event, some source for the increase in YC signal (or decrease in YV signal) must be determined. VELA instrument malfunction has been examined as a possibility but appears highly unlikely. Background changes arising from spurious reflections from the optical detector baffling surfaces has been advanced as a cause; some evidence presented late in our meetings indicates that this possibility should be pursued (it may be testable experimentally) but it is unlikely that such a reflection can account for the discrepancy.

The alternative explanation is that the September 22 event is not of earth origin. Viewed only in terms of YC/YV ratios, the September 22 event more closely resembles the zoo events than it does the known nuclear events. If no other mechanism for the YC/YV discrepancy can be determined, a near-by origin for the event must be considered more likely than an earth-based nuclear origin.

Alternate Explanations of the September 22 Event

The panel has examined a number of possible alternative sources of the bhangmeter signals on September 22, including unusual astronomical events, ordinary lightning, superbolts of lightning, sunlight reflection from other satellites, sunlight reflections from meteoroids near the satellite, and sunlight reflected from particles ejected from collision of meteoroids upon impact with the spacecraft. Lightning and superbolts produce single light peaks and have rise times too short to be confused with nuclear events. Meteoroids of sufficient size are too rare and travel too rapidly through the field of view to generate the observed time sequences. Unusual astronomical signals would have been observed by other sensors. Other satellites are too distant to reflect enough light to trigger the VELA bhangmeters. For these reasons, except for meteoroid impacts, all of the above have been ruled out as likely causes of the September 22 signal.

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At present a meteoroid impact with the VELA satellite appears to be the best candidate for a nonnuclear origin of the signal. Such an impact could generate secondary particles with a much greater mass than that of the meteoroid itself and moving with a low velocity relative to that of the satellite. The number of particles emitted can be quite large. These features provide a mechanism for generation of the complicated time histories seen in the unexplained zoo events as well as in the September 22 event. The short initial pulse could be accounted for by the entry of the first or first several particles from the ejecta into the field of view, and the long duration second-pulse from the large mass of ejecta which would soon follow. The event could be triggered by a meteoroid much smaller in size than would be required if the light signal had to be explained by reflection from the original meteoroid itself. Estimates made at SRI International show that such a collision can reasonably lead to the observed signal during the 10 years or so that the VELA system has been in operation.

There is additional indirect evidence from the Pioneer 10 spacecraft observations which supports this model. This spacecraft had both optical and impact sensors for meteoroid detection, but the frequency of signals recorded by the optical sensors on Pioneer 10 is two orders of magnitude greater than the detection rate recorded by its impact sensors. Interestingly, the Pioneer 10 optical observations are in reasonable agreement with the VELA zoo events, both being much more common than meteoroid impact measurements would suggest. By taking into account the much greater reflectivity of the large amount of material ejected from impact than that of the original meteoroid, one concludes that the satellite should observe large optical signals from the abundant small meteoroids that hit the satellite, rather than from close encounters with large meteoroids. Thus, the meteoroid impact model may account for both the zoo events and the high rate of optical observations of meteoroids by Pioneer 10.

Search for Supporting Data

Nuclear explosions produce fission products not otherwise found in the atmosphere and generate a variety of geophysical disturbances including hydroacoustic waves, acoustic waves, seismic signals, traveling ionospheric disturbances, electromagnetic pulses (EMP), and magnetic signals. Detection of radioactive fallout can be immediately confirmatory for a nuclear event. In contrast, geophysical signals from both natural and other artificial sources may resemble those from explosions. For low-yield explosions these geophysical signals are usually "noisy" and therefore by themselves cannot lead to unambiguous conclusions. At this time no data on EMP or magnetic disturbance that can be correlated with the September 22 signal are known to the panel. We describe below our assessment of the search for nuclear debris and data from the other geophysical sources.

a. Debris Collection

The efficiency of debris collection from a nuclear explosion is affected by the weather near the explosion site. Unstable weather and rain can significantly reduce the probability of debris collection due to rapid precipitation of debris. Weather data indicate broken clouds or overcast in much of the area of interest. [redacted] 1.5(g)

Since there was considerable uncertainty in the source location, debris collection missions were flown against air trajectories from four postulated locations (Kalahari Desert, Prince Edward Island, and two ocean locations representing possible sources of infrasonic-acoustic and hydroacoustic signals). In addition, more general search missions were flown to intercept the easterly air flow from other parts of the area of interest.

CT anomaly

Attempts to locate debris were made both by aircraft and an extensive program of ground-based sample collections. Background radiation is generally low in the Southern Hemisphere. A tentative positive result in New Zealand was subsequently shown to be erroneous. All other collections were negative, some of them indicating unusually low levels of background radiation.

Positive results from the debris collection effort would provide conclusive evidence of a nuclear explosion. However, the negative results actually obtained do not provide conclusive evidence that no nuclear explosion occurred.

b. Acoustic Data

An acoustic signal was recorded at a distant recording site in the northern hemisphere at an appropriate time. A second site in the same region had negative results for this event as did sensors in Australia. On the basis of expected propagation models for the season a better sound channel would be expected from the region of interest toward Australia than toward the northern hemisphere. Also, on the basis of AFTAC statistics for low-yield nuclear explosions, no signal would be expected at any of the above sites. In addition, there is a substantial probability of an uncorrelated signal arriving within the large time window allowed, since the position of the signal's origin is unknown. Thus, the acoustic data available are considered unrelated to this event.

c. Hydroacoustic Data

In a very preliminary analysis, a search by NRL has shown weak signals at SOSUS sites [redacted] 1.5(d) Signals a few decibels above background noise occur at these sites at times appropriate for direct arrivals from a source near Prince Edward Island and for rays reflected from the Antarctic ice shelf. These data were analyzed by a filtering procedure that is not normally used with SOSUS data, [redacted] 1.5(g)

question NRL

In the case of [redacted] 176 signals occurred above background during a 156-hour period. Similar information was not yet available for [redacted] This entire study is still too incomplete to apply to the event because no determination of background signal amplitude and occurrence have been furnished to resolve the question of ambiguity in signal identification and source locations. 1.5(d)

d. Traveling Ionospheric Disturbance (TID)

A TID consisting of a few aperiodic waves was observed by the Arecibo radar in Puerto Rico as traveling from SE to NW during several hours in the early morning of September 22. A S to N trace velocity of 1200 $\pm$300 meters per second (m/s) was reported. The true velocity is a function of the direction of propagation which was reported to be such as to give a value of 500 to 750 m/s, which are values typical of large-scale TIDs. Although a South-to-North propagation of large-scale TIDs from natural sources is considered unusual in low northern latitudes, only 120 hours of observation were available for this very sensitive instrument, providing a very weak data base. In this regard, weather satellite data of September 22 indicates that there was a tropical storm a few hundred miles from Arecibo at the time of interest and ionospheric disturbances are known to be generated by such storms. Longer observation at Arecibo may show such events more frequently. Also, a significant error in direction can reduce the true velocity to 150-200 m/s which is the realm of medium-scale TIDs. Arrival from the SE is not a rare event for the much more common medium-scale TIDs. In view of the inadequate data base, uncertainty in signal analysis, and alternative natural explanations, we do not at this time consider the Arecibo data as useful evidence related to the September 22 VELA signal.

Comments on the Nature of the Problem and Our Conclusions

The panel was charged with evaluating the significance of a single satellite observation combined with extensive additional data which were searched for and examined in consequence of that single observation. Specifically, the issue is to evaluate the likelihood that these observations provided persuasive evidence for the occurrence of a nuclear explosion. In concluding that it did not do so it is not necessary, and may in fact not be feasible, to provide a specific credible alternate explanation. This is not an unusual situation in ordinary scientific experience: many scientific investigations leave a residue of unexplained events. In particular, in approaching interpretations of a problem initiated by a single observation, the totality of available data may not provide a single persuasive explanation.

The preceding remark is intended to counter the concern that, "Well if it is not a nuclear explosion, then what is it?" We consider the alternative explanation of the September 22 signal as light reflected from debris ejected from the spacecraft as reasonable, but we do not maintain that this particular explanation is necessarily correct.

We do in fact find that the VELA signal of September 22, 1979, contains sufficient internal inconsistency to cast serious doubt whether that signal originated from a nuclear explosion or in fact from any light source not in the proximity of the VELA satellite. Moreover, AFTAC provided the panel with hundreds of signals which constitute a family of unexplained zoo events clearly not generated by nuclear explosions. The September 22, 1979, event may be considered as a possible member of that group.

As discussed elsewhere, the search for supplementary evidence on the nature of the September 22, 1979, event has provided extensive data of varying relevance to the problem. The panel recognizes that there is evidentiary value both in the paucity of such ancillary data as well as in the content of the data obtained.

For example, one could, in this case, gather individual pieces of information that suggest the September 22 event was a nuclear explosion, assign a false alarm probability to each source of information, then multiply these probabilities. This method necessarily results in a small number and is then taken as corroborative evidence of the nuclear origin of the signal. But this method fails to take into account all relevant information--e.g., data that conflicts with the hypothesis that a nuclear explosion occurred as well as the absence of data from certain sensors or locations. We surmise that had a search been made for corroborating data relevant to a nonexistent event chosen to occur at a random time, such a search would have provided "corroborative data" of similar quantity and quality to that which has been found during analysis of the September 22 signal.

Although the panel is not able to compute the likelihood of the November 22, 1979, event being a nuclear explosion, based on our experience in related scientific assessments, it is our collective judgment that the September 22 signal was probably not from a nuclear explosion.

APPENDIX

AD HOC PANEL ON THE SEPTEMBER 22 EVENT

Panel members:

Dr. Jack Ruina, Chairman	Department of Electrical Engineering Massachusetts Institute of Technology
Dr. Luis Alvarez	Department of Physics University of California, Berekely
Dr. William Donn	Lamont-Doherty Geological Observatory Columbia University
Dr. Richard Garwin	Thomas J. Watson Research Center IBM
Dr. Riccardo Giacconi	Harvard/Smithsonian Center for Astrophysics Harvard University
Dr. Richard Muller	Department of Physics University of California, Berekely
Dr. Wolfgang Panofsky	Stanford Linear Accelerator Center Stanford University
Dr. Allen Peterson	Department of Electrical Engineering Stanford University
Dr. F. Williams Sarles	Lincoln Laboratory Massachusetts Institute of Technology