EXECUTIVE OFFICE OF THE PRESIDENT
NATIONAL AERONAUTICS and SPACE COUNCIL
WASHINGTON

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MEMORANDUM FOR

Mr. Robert F. Packard
Office of International Scientific Affairs
Department of State
Washington 25, D. C.

SUBJECT: Thoughts on the Space Alien Race Question

During recent discussions the question has occasionally, though rarely, arisen that perhaps we should consider the policy question of what to do if an alien intelligence is discovered in space. Some discussion of this occurred, as you will recall, during deliberations on BNSP Task I. This memo contains some miscellaneous thoughts on the question.

The consensus of scientific view says, with quite good reasons, that the possibility of running across an alien intelligent race in our solar system is negligible. This is due primarily to the presumed unsuitability of conditions upon other planets to support life as we know it. The flying saucer advocates claim, of course, that the scientific viewpoint is nonsense, and that there is overwhelming evidence of such beings. In my own mind, I find it difficult to side with the flying saucer advocates, but the almost total impossibility envisioned by most scientists also is disturbing. Therefore, I present the problem in current perspective, as I see it.

Up until a few decades ago it seemed very improbable that intelligent life existed anywhere outside of the solar system. The chief reasons for this were a combination of scientific theory, scientific knowledge, and religious belief. The most widely accepted scientific theory as to the formation of the solar planetary system held that it was a result of the near collision of two stars. Since such a precise near-miss

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備忘錄致

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主題：關於外星種族問題的思考

在近期的討論中，偶爾——雖然罕見——會出現一個問題：或許我們該考慮政策層面，若在太空中發現外星智慧生命該如何應對。如您所憶，這在BNSP第一任務的審議中曾有過一些討論。這份備忘錄收錄了對此問題的一些雜亂想法。

科學界的共識——且有相當充分的理由——認為，在我們太陽系內遇到外星智慧種族的可能性微乎其微。這主要是因為其他行星的條件被認為不適合我們所知的生命形式存在。當然，飛碟倡導者聲稱科學觀點純屬無稽之談，並有壓倒性證據證明這類生物的存在。在我個人看來，我難以站在飛碟倡導者一邊，但大多數科學家所設想的幾乎完全不可能性也令人不安。因此，我以當前視角呈現這個問題，如我所見。

直到幾十年前，太陽系外存在智慧生命的可能性似乎極低。主要原因在於科學理論、科學知識與宗教信仰的結合。關於太陽系行星系統形成的最廣為接受的科學理論認為，這是兩顆恆星近乎相撞的結果。由於如此精確的擦身而過

of two stars would be an extremely rare event, it followed that there would be very few other planetary systems in the universe and, indeed, perhaps this was the only one. Religious belief said, furthermore, that life was a gift bestowed by God. This was a relatively undisputed point since no scientific data existed to bridge the gap between non-living and living materials.

The situation today is vastly changed in these respects. The most widely held theory of stellar formation would predict the formation of planetary systems to be a natural consequence of stellar evolution. On this basis, most stars would possess planetary systems, and the number of habitable planets in our galaxy would be tremendous. Our biggest telescopes cannot resolve planets at the distances even of the nearest stars, so no direct confirmation is yet available. In my own mind, however, the wide prevalence of multiple stars is an overwhelming hint in support of this theory. In addition, the biological sciences have almost completely traced a series of natural occurrences which lead from inanimate molecules to elementary living viruses. Thus, we have the current scientific theory and data not only that there are a huge number of planets in the galaxy, but that life is quite likely to arise spontaneously on a large number of these. This, of course, does not necessarily imply intelligent life. Modern theology is not necessarily incompatible with this. The description in Genesis of the Creation certainly is a better picture of the current theory than of a stellar collision, and since God only spent seven days on this system, He has clearly had lots of time to create many more systems.

Even granting a probable existence of much life in the galaxy, there is still the question of whether another intelligent race exists in our solar system. There are, of course, two methods of its establishment in our system. One of these is that it originated on some other planet, for instance, Mars. Some of the spectacular markings of Mars have been interpreted as indicating intelligence. In particular, the famous "Canali" are rather narrow, and always run from one prominent marking to another, frequently with round splotches at intersections. As far as I know, no one has discovered a "Canali" which goes nowhere. This has quite understandably stimulated much conversation. In fact, a number of decades ago, when scientists thought that any life on other stellar systems was very remote, they seemed to feel that intelligent life

兩顆恆星的碰撞將是極其罕見的事件，因此宇宙中其他行星系統的數量會非常稀少，甚至可能只有我們這一個。宗教信仰更進一步指出，生命是上帝賜予的禮物。這在當時幾乎是無可爭議的觀點，因為沒有科學數據能填補非生命物質與生命物質之間的鴻溝。

如今，情況在這些方面已大不相同。最廣為接受的恆星形成理論認為，行星系統的形成是恆星演化的自然結果。基於此，大多數恆星都擁有行星系統，而我們銀河系中適宜居住的行星數量將極為龐大。即便使用最大的望遠鏡，也無法解析距離我們最近的恆星周圍的行星，因此目前尚無直接證據。然而，在我看來，多星系統的普遍存在是一個壓倒性的線索，支持了這一理論。此外，生物科學幾乎完整地追溯了一系列自然過程，這些過程從無機分子逐步發展到基本的活病毒。因此，我們現有的科學理論與數據不僅顯示銀河系中存在大量行星，更表明生命很可能在許多行星上自發產生。當然，這並不一定意味著有智慧生命的存在。現代神學與此並非必然衝突。《創世記》中對創造的描述，顯然比恆星碰撞理論更貼近當前的觀點；既然上帝只花了七天創造我們這個系統，祂顯然有充足的時間創造更多系統。

即使承認銀河系中很可能存在大量生命，我們仍要問：太陽系中是否存在另一個智慧種族？當然，它們出現在我們系統中有兩種可能方式。其一，它們起源於其他行星，例如火星。火星上一些引人注目的標記被解讀為智慧的跡象。尤其著名的「運河」相當狹窄，總是從一個顯著標記延伸到另一個，交會處常有圓形斑點。據我所知，尚未有人發現一條「無所通往」的運河。這自然引發了大量討論。事實上，幾十年前，當科學家認為其他恆星系統存在生命的可能性極低時，他們似乎傾向於認為智慧生命

probably existed on our other planets. Some of the discussions about life on Mars at the turn of the century seem to indicate a strong urge to want to find intelligent life elsewhere. Today, the situation is completely reversed, and although intelligent life is considered quite probable among the stars, it is held to be quite unlikely within the solar system. We seem more eager to listen with Ozma than to look closely at Canali.

One school of flying saucer advocates claims that the Martians have been mining our moon for natural resources for some time. At first thought, one would think they would rather mine earth. It is interesting to speculate, however, upon space flight from the point of view of a Martian. The escape speed of Mars is only 16,500 fps, and, of course, braking speed on our moon is less than 10,000 fps. Thus, Martians looking at earth would tend to view it the same way Terrestrials look at Jupiter. Our moon might not be less work to get to, since atmospheric braking to earth is possible, but would be very much easier to return from, while the energy requirements to go to and return from the surface of the earth might well be so high as to discourage interest, at least initially. Interestingly enough, even a normal high energy chemical rocket could make a trip from Mars to our moon at favorable times while carrying almost 10% of its gross weight in payload. Space flight starting from Mars, then, is a much easier prospect than starting from Terra. If a suitable refueling base had been painfully established on our moon, the operation could be done quite commendably with merely chemical energy. (The aforementioned high energy chemical rocket could carry at favorable times almost 50% payload back to Mars.) Of course, many flying saucer advocates claim that the discovery of both Martian moons within a week in the latter part of the Nineteenth Century indicates that they are large artificial space stations, otherwise they would have been found earlier. If we were to discover Martians on the moon, it would result in surprisingly little readjustment of our scientific thinking. The biggest question would be why they were there rather than among the Asteroids.

In fact, if we were not as scientifically sure of ourselves as we are, three recent events would be hailed as broad hints of intelligent life on the moon. (1) The discovery of hot gasses eminating from the crater Alphonsus when the moon was supposedly dead. This would be considered evidence of civilization and, since Alphonsus is close to the visible edge, interpreted to mean that the other side of the moon was teaming with population which had begun

很可能存在於我們的其他行星上。世紀之交時關於火星生命的討論，似乎顯示出強烈的渴望，想在其他地方找到智慧生命。如今，情況完全相反，雖然星際間被認為很可能存在智慧生命，但在太陽系內卻被視為極不可能。我們似乎更熱衷於用奧茲瑪計畫去聆聽，而非仔細觀察卡納利運河。

有一派飛碟支持者聲稱，火星人已經在我們的月球上開採自然資源一段時間了。乍想之下，人們會認為他們寧可開採地球。然而，從火星人的角度來思考太空飛行，倒是頗有意思。火星的逃逸速度僅有每秒16, 500英尺，而我們月球的減速速度則低於每秒10, 000英尺。因此，火星人看待地球的方式，很可能就像地球人看待木星一樣。我們的月球或許並非更容易到達，因為地球有大氣減速的可能，但從月球返回卻輕鬆許多；而往返地球表面的能量需求可能高得令人卻步，至少一開始是如此。有趣的是，即使是普通的強力化學火箭，也能在有利時機從火星飛往月球，同時攜帶近10%的總重作為有效載荷。因此，從火星出發的太空飛行，遠比從地球出發容易得多。如果在我們的月球上辛苦建立一個合適的燃料補給基地，那麼僅用化學能就能出色地完成任務。（前述的強力化學火箭在有利時機，可攜帶近50%的有效載荷返回火星。）當然，許多飛碟支持者聲稱，十九世紀後半葉在一週內接連發現火星的兩顆衛星，顯示它們是巨大的人造太空站，否則早就該被發現了。如果我們在月球上發現火星人，對科學思維的調整將會出乎意料地小。最大的問題會是：他們為何在那裡，而非在小行星帶中。

事實上，如果我們沒有像現在這樣對科學如此自信，那麼近期的三起事件就會被視為月球上存在智慧生命的明顯跡象。（1）在阿爾方索斯隕石坑發現熱氣體噴發，而月球據推測已是死寂天體。這會被視為文明的證據，且由於阿爾方索斯靠近可見邊緣，這將被解讀為月球背面充滿了人口，他們已經開始……

to spill around to this side. (2) The infra-red scans which show hot spots. These would be interpreted as indications of cities or at least mining camps. (3) The fact that no lunar or planetary probe of significance has been successful, in spite of major efforts on the part of two very successful earth orbitfaring nations. It would be supposed that someone was denying us deep space. (The other-side-of-the-moon pictures from Lunik III show no details of consequence, and the same can be said of the data from Mariner II compared to what we had already known about Venus from earth-based measurements.) Should the Martians have colonized the moon without discovering nuclear energy, then they represent no real problem, and our current national policy would be made to order for the situation. If all of this were true, of course, I would expect the Martians to be scared to death of what they have seen recently on this planet, and would expect that the highest priority development program in the solar system is being conducted by the Atomic Energy Commission of Mars.

Even if we are secure in our belief that intelligent life never would develop on Mars or some other solar planet, there is still the question of visitors to the solar system from other stellar systems. This is normally written off as an extremely low probability, due to the tremendous distances between stars, and the Einstein limitation on travel faster than the speed of light. Therefore, even if there are a large number of intelligent life forms in the galaxy, and even if they are continuously searching for other races, the frequency of investigation of any stellar system would be only once in many thousand of years and contact would rarely, if ever, be achieved. It might never be achieved, since presumably intelligent races die out. (What happened to the planet whose pieces now are spread around the Asteroid Belt? Or, for that matter, why is Uranus lying on its side?) I am not sure that this travel restriction is quite as infallible as it sounds. I believe that it is possible with what we now know about nuclear energy to envision ships driven at half to three-quarters of the speed of light. This, since the galaxy is 100,000 light-years across, still does not make a search of the entire galaxy feasible within the life span of the average man. But suppose some race under pressure of population explosion were expanding as fast as technically feasible from star to star throughout the galaxy. If their ships averaged half the speed of light, and if, on the average, they stopped every 10 light-years for a twenty-year stay at a stellar system to deposit colonists, refuel, and build extra ships, they would only take two hundred thousand years, starting at the center of the galaxy, to spread

（2）紅外線掃描顯示的熱點，這些會被解讀為城市或至少是採礦營地的跡象。（3）儘管兩個在近地軌道航行方面極為成功的國家付出了重大努力，卻沒有任何重要的月球或行星探測器成功過。這讓人猜想，是否有人刻意阻擋我們深入太空。（來自月球三號的月球背面照片並未顯示出任何有意義的細節，而水手二號的數據，與我們從地球測量已知的金星資訊相比，也同樣乏善可陳。）如果火星人已經殖民月球卻未發現核能，那麼他們並不構成真正的威脅，我們現行的國家政策也正好能應對這種情況。當然，如果這一切都是真的，我會預期火星人對他們最近在地球上看到的景象感到極度恐懼，並且預期太陽系中最高優先級的開發計畫，正由火星原子能委員會主導。

即使我們堅信火星或其他太陽系行星上不可能發展出智慧生命，仍存在來自其他恆星系統的訪客造訪太陽系的問題。這通常被認為機率極低，因為恆星之間的距離極其遙遠，加上愛因斯坦對超光速旅行的限制。因此，即使銀河系中存在大量智慧生命形式，且它們持續尋找其他種族，對任何一個恆星系統的調查頻率也只會是數千年一次，而接觸——即便有——也極少能實現。或許永遠無法實現，因為智慧種族很可能會滅絕。（那些如今散落在小行星帶的行星碎片，其母星發生了什麼？或者，天王星為何側躺？）我不確定這種旅行限制是否如聽起來那般牢不可破。我相信，以我們目前對核能的了解，設計出以光速一半到四分之三速度航行的飛船是可能的。然而，由於銀河系直徑達十萬光年，這仍無法在一般人壽命內完成對整個銀河系的探索。但假設某個種族在人口爆炸的壓力下，以技術上可行的速度從一顆恆星擴散到另一顆恆星，遍布整個銀河系。如果他們的飛船平均速度為光速的一半，且平均每十光年停留二十年，在一個恆星系統中殖民、補給燃料並建造額外飛船，那麼從銀河系中心出發，他們只需二十萬年就能擴散開來。

throughout the whole system. Since the earliest known remains of man have recently been dated at approximately one million seven-hundred thousand years, a sustained drive for merely two hundred thousand years may not be unreasonable. Of course, if we were to run across representatives of this kind of interstellar race, they would not be nearly as tame as the previously hypothesized chemical Martians, and our policy would need to be revised accordingly. Fortunately, travel time restrictions would inhibit their ability to bring all forces to bear, in case we should develop differences of viewpoint.

The third possibility, scientifically abhorrent, is that the Einstein theory may only be an approximation, and an alien race which actually travels faster than light exists. If we were to meet such a race, our policy had better be to negotiate fast, because the implications of their far better understanding and control of the fundamental forces of nature would be obvious. If all the scientific speculation were to turn out wrong and we were to stumble across an alien race, we would want to know as quickly as possible which of the three types I have indicated it was, as our diplomatic policy would damned well be influenced by the results.

CONCLUSIONS

Although all plausible scientific thinking suggests that we will not find any other intelligence race, the probability that we will is finite, and perhaps should not be completely ignored. Were we to find one, the question of whether it was a race with primitive chemical space flight, space flight equivalent to our best understanding of nuclear energy, or space flight based on physics beyond Einstein should be ascertained as rapidly as possible, since our policies would be affected in the most drastically possible way. In any event, a policy of the immediate burying of all Terrestrial hatchets would likely be in order. Even if we only found tame chemical Martians, or merely the debris from some intra-glactic survey mission, it would be a good idea to proceed on the assumption that the human race would finally have found a bigger problem than the ones it has created for itself. There likely is nothing to be done at

在整個系統中。由於已知最早的人類遺骸最近被測定為約一百七十萬年前，因此持續推動僅二十萬年或許並非不合理。當然，如果我們遇到這類星際種族的代表，他們絕不會像先前假設的化學火星人那樣溫馴，而我們的政策也需相應調整。幸運的是，旅行時間的限制會削弱他們在我們觀點分歧時動用全部力量的能力。

第三種可能性，在科學上令人厭惡，是愛因斯坦理論可能僅為近似值，而存在一個實際以超光速旅行的外星種族。如果我們遇到這樣的種族，我們最好迅速談判，因為他們對自然基本力量的更深刻理解與掌控所帶來的影響顯而易見。如果所有科學推測都錯了，而我們偶然碰上一個外星種族，我們需要盡快判斷它屬於我所指出的三種類型中的哪一種，因為我們的外交政策將受到結果的極大影響。

結論

儘管所有合理的科學思考都表明我們不會發現其他智慧種族，但這種可能性仍然存在，或許不應完全忽視。如果我們真的發現一個，則應盡快確認它是屬於原始化學太空飛行、相當於我們對核能最佳理解的太空飛行，還是基於超越愛因斯坦物理學的太空飛行，因為我們的政策將因此受到最劇烈的影響。無論如何，立即擱置地球上所有紛爭的政策可能都是恰當的。即使我們只發現溫馴的化學火星人，或僅是某次星系內調查任務的殘骸，也應假設人類最終會找到一個比它為自己所製造的問題更重大的問題，以此為前提來行動。目前很可能無事可做，

the moment to prepare for these possibilities (the only body of writing on the subject available in an emergency is science fiction), because no one of consequence is going to take this rubbish seriously unless it happens. At that point, our policy will be determined in the traditional manner of grand panic.

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為這些可能性做好準備的時刻（在緊急情況下唯一可用的相關書面資料是科幻小說），因為除非這些事情真的發生，否則沒有哪位重要人物會認真看待這堆廢話。屆時，我們的政策將按照傳統的大恐慌方式來決定。

麥克斯韋·W·亨特二世