

ELECTROGRAVITICS SYSTEMS

An examination of electrostatic motion,
dynamic counterbary and barycentric control.

AVIATION STUDIES INTERNATIONAL, LTD.

SPECIAL WEAPONS STUDY UNIT
93-31 Cheval Place, Knightsbridge
London S.W.7. England

During mid-1995, Mr. James Hartman of Griffith, Indiana, and Dale Goudie, CUFON Information Director, engaged in a series of telephone conversations during which a discussion of some documents Mr. Hartman had obtained ensued. Mr. Hartman was generous to provide Mr. Goudie with copies of some of these documents.

One of these, ELECTROGRAVITICS SYSTEMS; An examination of electrostatic motion, dynamic counterbary and barycentric control is contained in this file.

CUFON does not espouse any particular theory or 'school of thought' about UFO or related subjects. However, this report, dated as it is in the 1950's, gives one pause to wonder that the prospect of discovering gravity control was deemed very possible at that date, and before; that research 'rigs' were in operation in the R & D facilities of most major aviation companies. One wonders: It seems that sufficient time has elapsed for major developments in this area to have been made.

We proceeded to verify the document. Please find below a copy of the release letter and the text of the report.

08-OCT-95 Dale Goudie Jim Klotz

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DEPARTMENT OF THE AIR FORCE
WRIGHT LABORATORY (AFMC)
WRIGHT-PATTERSON AIR FORCE BASE OHIO

AUG 09 1995

MEMORANDUM FOR: Mr. Dale Goudie

FROM: AIR FORCE INFORMATION FOR INDUSTRY OFFICE

WL/DORT
Area B Bldg 22 Room S-122
2960 C Street
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SUBJECT: Request for documents

The report, which you requested, from the United Kingdom is enclosed with this letter. The document could have been obtained through inter-library loan.

If you have any questions, please telephone David Ryans at (513) 255-5767

DAVID A. RYANS
Technical Information Specialist
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ELECTROGRAVITICS SYSTEMS

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It has been accepted as axiomatic that the way to offset the effects of gravity is to use a lifting surface and considerable molecular energy to produce a continuously applied force that, for a limited period of time, can remain greater than the effects of gravitational attraction. The original invention of the glider, and evolution of the briefly self-sustaining glider, at the turn of the century led to progressive advances in power and knowledge. This has been directed to refining the classic Wright Brothers' approach. Aircraft design is still fundamentally as the Wrights adumbrated it, with wings, body, tails, moving or flapping controls, landing gear and so forth. The Wright biplane was a powered glider, and all subsequent aircraft, including the supersonic jets of the nineteen-fifties are also powered gliders. Only one fundamentally different flying principle has so far been adopted with varying degrees of success. It is the rotating wing aircraft that has led to the jet lifters and vertical pushers, coleopters, ducted fans and lift induction turbine propulsion systems .

But during these decades there was always the possibility of making efforts to discover the nature of gravity from cosmic or quantum theory, investigation and observation, with a view to discerning the physical properties of aviation's enemy.

It has seemed to Aviation Studies that for some time insufficient attention has been directed to this kind of research. If it were successful such developments would change the concept of sustentation, and confer upon a vehicle qualities that would now be regarded as the ultimate in aviation.

This report summarizes in simple form the work that has been done and is being done in the new field of electrogravitics. It also outlines the various possible lines of research into the nature and constituent matter of gravity, and how it has changed from Newton to Einstein to the modern Hlavaty concept of gravity as an electromagnetic force that may be controlled like a light wave.

The report also contains an outline of opinions on the feasibility of different electrogravitics systems and there is reference to some of the barycentric control and electrostatic rigs in operation.

Also included is a list of references to electrogravitics in successive Aviation Reports since a drive was started by Aviation Studies International Limited to suggest to aviation business eighteen months ago that the rewards of success are too far-reaching to be overlooked, especially in view of the hopeful judgment of the most authoritative voices in microphysics. Also listed are some relevant patents on electrostatics and electrostatic generators in the United States, United Kingdom and France.

Gravity Research Group
25 February 1956

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DISCUSSION

Electrogravitics might be described as a synthesis of electrostatic energy used for propulsion - either vertical propulsion or horizontal or both - and gravitics, or dynamic counterbary, in which energy is also used to set up a local gravitational force independent of the earth's.

Electrostatic energy for propulsion has been predicted as a possible means of propulsion in space when the thrust from a neutron motor or ion motor would be sufficient in a dragless environment to produce astronomical velocities. But the ion motor is not strictly a part of the science of electrogravitics, since barycentric control in an electrogravitics system is envisaged for a vehicle operating within the earth's environment and it is not seen initially for space application. Probably large scale space operations would have to await the full development

of electrogravitics to enable large pieces of equipment to be moved out of the region of the earth's strongest gravity effects. So, though electrostatic motors were thought of in 1925, electrogravitics had its birth after the War, when Townsend Brown sought to improve on the various proposals that then existed for electrostatic motors sufficiently to produce some visible manifestation of sustained motion. Whereas earlier electrostatic tests were essentially pure research. Brown's rigs were aimed from the outset at producing a flying vehicle. As a private venture he produced evidence of motion using condensers in a couple of saucers suspended by arms rotating round a central tower with input running down the arms. The massive-k situation was summarized subsequently in a report, Project Winterhaven, in 1952. Using the data some conclusions were arrived at that might be expected from ten or more years of intensive development - similar to that, for instance, applied to the turbine engine. Using a number of assumptions as to the nature of gravity, the report postulated a saucer as the basis of a possible interceptor with Mach 3 capability. Creation of a local gravitational system would confer upon the fighter the sharp-edged changes of direction typical of motion in space.

The essence of electrogravitics thrust is the use of a very strong positive charge on one side of the vehicle and a negative on the other. The core of the motor is a condenser and the ability of the condenser to hold its charge (the k-number) is the yardstick of performance. With air as 1, current dielectrical materials can yield 6 and use of barium aluminate can raise this considerably, barium titanium oxide (a baked ceramic) can offer 6,000 and there is promise of 30,000, which would be sufficient for supersonic speed.

The original Brown rig produced 30 fps on a voltage of around 50,000 and a small amount of current in the milliamp range. There was no detailed explanation of gravity in Project Winterhaven, but it was assumed that particle dualism in the subatomic structure of gravity would coincide in its effect with the issuing stream of electrons from the electrostatic energy source to produce counterbary. The Brown work probably remains a realistic approach to the practical realization of electrostatic propulsion and sustentation. Whatever may be discovered by the Gravity Research Foundation of New Boston a complete understanding and synthetic reproduction, of gravity is not essential for limited success. The electrogravitics saucer can perform the function of a classic lifting surface - it produces a pushing effect on the under surface and a suction effect on the upper, but, unlike the airfoil, it does not require a flow of air to produce the effect.

First attempts at electrogravitics are unlikely to produce counterbary, but may lead to development of an electrostatic VTOL vehicle. Even in its developed form this might be an advance on the molecular heat engine in its capabilities. But hopes in the new science depend on an understanding of the close identity of electrostatic motivating forces with the source and matter of gravity. It is fortuitous that lift can be produced in the traditional fashion and if an understanding of gravity remains beyond full practical control, electrostatic lift might be an adjunct of some significance to modern thrust producers. Research into electrostatics could prove beneficial to turbine development, and heat engines in general, in view of the usable electron potential round the periphery of any flame. Materials for electrogravitics and especially the development of commercial quantities of high-k material is another dividend to be obtained from electrostatic research even if it produces no counterbary. This is a line of development that Aviation Studies' Gravity Research Group is following.

One of the interesting aspects of electrogravitics is that a breakthrough in almost any part of the broad front of general research on the intranuclear processes may be translated into a meaningful advance towards the feasibility of electrogravitics systems. This demands constant monitoring in the most likely areas of the physics of high energy sub-nuclear particles. It is difficult to be overoptimistic about the prospects of gaining so complete a grasp of gravity while the world's physicists are still engaged in a study of fundamental particles - that is to say those that cannot be broken down any more. Fundamental particles are still being discovered - the most recent was the Segre-Chamberlain-Wiegand attachment to the bevatron, which was used to isolate the missing anti-proton, which must - or should be presumed to - exist according to Dirac's theory of the electron. Much of the accepted

mathematics of particles would be wrong if the anti-proton was proved to be non-existent. Earlier Eddington has listed the fundamental particles as:

- e. The charge of an electron.
- m. The mass of an electron.
- M. The mass of a proton.
- h. Planck' s constant
- c. The velocity of light.
- G. The constant of gravitation, and
- x. The cosmical constant.

It is generally held that no one of these can be inferred from the others. But electrons may well disappear from among the fundamental particles, though, as Russell says, it is likely that e and m will survive. The constants are much more established than the interpretation of them and are among the most solid of achievements in modern physics.

* * *

Gravity may be defined as a small scale departure from Euclidean space in the general theory of relativity. The gravitational constant is one of four dimensionless constants: first, the mass relation of the nucleon and electron. Second is e^2/hc , (e squared over hc) third, the Compton wavelength of the proton, and fourth is the gravitational constant, which is the ratio of the electrostatic to the gravitational attraction between the electron and the proton.

One of the stumbling blocks in electrogravitics is the absence of any satisfactory theory linking these four dimensionless quantities. Of the four, moreover, gravity is decidedly the most complex, since any explanation would have to satisfy both cosmic and quantum relations more acceptably and intelligibly even than in the unified field theory. A gravitational constant of around 10^{-39} (10 to the minus 39th power) has emerged from quantum research and this has been used as a tool for finding theories that could link the two relations. This work is now in full progress, and developments have to be watched for the aviation angle. Hitherto Dirac, Eddington, Jordan and others have produced differences in theory that are too wide to be accepted as consistent. It means therefore that (i) without a cosmical basis, and (ii) with an imprecise quantum basis and (iii) a vague hypothesis on the interaction, much remains still to be discovered. Indeed some say that a single interacting theory to link up the dimensionless constants is one of three major unresolved basic problems of physics. The other two main problems are the extension of quantum theory and a more detailed knowledge of the fundamental particles.

All this is some distance from Newton, who saw gravity as a force acting on a body from a distance, leading to the tendency of bodies to accelerate towards each other. He allied this assumption with Euclidean geometry, and time was assumed as uniform and acted independently of space. Bodies and particles in space normally moved uniformly in straight lines according to Newton, and to account for the way they sometimes do not do so, he used the idea of a force of gravity acting at a distance, in which particles of matter cause in others an acceleration proportional to their mass, and inversely proportional to the square of the distance between them.

But Einstein showed how the principle of least action, or the so-called cosmic laziness means that particles, on the contrary, follow the easiest path among geodesic lines and as a result they get readily absorbed into space-time. So was born non-linear physics. The classic example of non-linear physics is the experiment in bombarding a screen with two slits. When both slits are open particles going through are not the sum of the two individually but follows a non-linear equation. This leads on to wave-particle dualism and that in turn to the Heisenberg uncertainty principle in which an increase in accuracy in measurement of one physical quantity means decreasing accuracy in measuring the other. If time is measured

accurately energy calculations will be in error; the more accurate the position of a particle is established the less certain the velocity will be, and so on. This basic principle of the acausality of microphysics affects the study of gravity in the special and general theories of relativity. Lack of pictorial image in the quantum physics of this interrelationship is a difficulty at the outset for those whose minds remain obstinately Euclidean.

In the special theory of relativity, space-time is seen only as an undefined interval which can be defined in any way that is convenient and the Newtonian idea of persistent particles in motion to explain gravity cannot be accepted. It must be seen rather as a synthesis of forces in a four dimensional continuum, three to establish the position and one the time. The general theory of relativity that followed a decade later was a geometrical explanation of gravitation in which bodies take the geodesic path through space-time. In turn this means that instead of the idea of force acting at a distance it is assumed that space, time, radiation and particles are linked and variations in them from gravity are due rather to the nature of space.

Thus gravity of a body such as the earth, instead of pulling objects towards it as Newton postulated, is adjusting the characteristics of space and, it may be inferred, the quantum mechanics of space in the vicinity of the gravitational force. Electrogravitics aims at correcting this adjustment to put matter, so to speak, 'at rest'.

* * *

One of the difficulties in 1954 and 1955 was to get aviation to take electrogravitics seriously. The name alone was enough to put people off. However, in the trade much progress has been made and now most major companies in the United States are interested in counterbary. Groups are being organised to study electrostatic and electromagnetic phenomena. Most of industry's leaders have made some reference to it. Douglas has now stated that it has counterbary on its work agenda but does not expect results yet awhile. Hiller has referred to new forms of flying platform, Glenn Martin say gravity control could be achieved in six years, but they add that it would entail a Manhattan District type of effort to bring it about. Sikorsky, one of the pioneers, more or less agrees with the Douglas verdict and says that gravity is tangible and formidable, but there must be a physical carrier for this immense trans-spatial force. This implies that where a physical manifestation exists, a physical device can be developed for creating a similar force moving in the opposite direction to cancel it. Clarke Electronics state they have a rig, and add that in their view the source of gravity's force will be understood sooner than some people think. General Electric is working on the use of electronic rigs designed to make adjustments to gravity - this line of attack has the advantage of using rigs already in existence for other defence work. Bell also has an experimental rig intended, as the company puts it, to cancel out gravity, and Lawrence Bell has said he is convinced that practical hardware will emerge from current programs. Grover Leoning is certain that what he referred to as an electro-magnetic contra-gravity mechanism will be developed for practical use. Convair is extensively committed to the work with several rigs. Lear Inc., autopilot and electronic engineers have a division of the company working on gravity research and so also has the Sperry division of Sperry-Rand. This list embraces most of the U.S. aircraft industry. The remainder, Curtiss-Wright, Lockheed, Boeing and North American have not yet declared themselves, but all these four are known to be in various stages of study with and without rigs.

In addition, the Massachusetts Institute of Technology is working on gravity, the Gravity Research Foundation of New Boston, the Institute for Advanced Study at Princeton, the CalTech Radiation Laboratory, Princeton University and the University of North Carolina are all active in gravity. Glenn L. Martin is setting up a research Institute for Advanced Study which has a small staff working on gravity research with the unified field theory and this group is committed to extensive programs of applied research. Many others are also known to be studying gravity, some are known also to be planning a general expansion in this field, such as in the proposed Institute for Pure Physics at the University of North Carolina.

A certain amount of work is also going on in Europe. One of the French nationalized constructors and one company outside the nationalized elements have been making

preliminary studies, and a little company money has in one case actually been committed. Some work is also going on in Britain where rigs are now in existence. Most of it is private venture work, such as that being done by Ed Hull, a colleague of Townsend Brown who, as much as anybody, introduced Europe to electrogravitics. Aviation Studies' Gravity Research Group is doing some work, mainly on k studies, and is sponsoring dielectric investigations.

One Swedish company and two Canadian companies have been making studies, and quite recently the Germans have woken up to the possibilities. Several of the companies have started digging out some of the early German papers on wave physics. They are almost certain to plan a gravitics program. Curiously enough the Germans during the war paid no attention to electrogravitics. This is one line of advance that they did not pioneer in any way and it was basically a U.S. creation. Townsend Brown in electrogravitics is the equivalent of Frank Whittle in gas turbines. This German overlooking of electrostatics is even more surprising when it is remembered how astonishingly advanced and prescient the Germans were in nuclear research. The modern theory of making thermonuclear weapons without plutonium fission initiators returns to the original German idea that was dismissed, even ridiculed. The Germans never went very far with fission, indeed they doubted that this chain would ever be made to work. The German air industry, still in the embryo stage, has included electrogravitics among the subjects it intends to examine when establishing the policy that the individual companies will adopt after the present early stage of foreign licence has enabled industry to get abreast of the other countries in aircraft development.

* * *

It is impossible to read thorough this summary of the widening efforts being made to understand the nature of matter of gravity without sharing the hope that many groups now have, of major theoretical breakthroughs occurring before very long. Experience in nucleonics has shown that, when attempts to win knowledge on this scale are made, advances are soon seen. There are a number of elements in industry, and some managements, who see gravity as a problem for later generations. Many see nothing in it all and they may be right. But as said earlier, if Dr. Vaclav Hlavaty thinks gravity is potentially controllable that surely should be justification enough, and indeed inspiration, for physicists to apply their minds and for management to take a risk. Hlavaty is the only man who thinks he can see a way of doing the mathematics to 'demonstrate Einstein's unified field theory - something that Einstein himself said was beyond him. Relativity and the unified field theory go to the root of electrogravitics and the shifts in thinking, the hopes and fears, and a measure of progress is to be obtained only in the last resort from men of this stature.

Major theoretical breakthroughs to discover the sources of gravity will be made by the most advanced intellects using the most advanced research tools. Aviation's role is therefore to impress upon physicists of this calibre with the urgency of the matter and to aid them with statistical and peripheral investigations that will help to clarify the background to the central mathematical and physical puzzles. Aviation could also assist by recruiting some of these men as advisers. Convair has taken the initiative with its recently established panel of advisers on nuclear projects, which include Dr. Edward Teller of the University of California. At the same time much can be done in development of laboratory rigs, condenser research and dielectric development, which do not require anything like the same cerebral capacity to get results and make a practical contribution.

As gravity is likely to be linked with the new particles, only the highest powered particle accelerators are likely to be of use in further fundamental knowledge. The country with the biggest tools of this kind is in the best position to examine the characteristics of the particles and from those countries the greatest advances seem most likely.

Though the United States has the biggest of the bevatrons - the Berkeley bevatron is 6.2 bev - the Russians have a 10 bev accelerator in construction which, when it is completed, will be the world's largest. At Brookhaven a 25 bev instrument is in development which, in turn, will be the biggest. Other countries without comparable facilities are of course at a great disadvantage from the outset in the contest to discover the explanation of gravity.

Electrogravitics, moreover, unfortunately, competes with nuclear studies for its facilities. The clearest thinking brains are bound to be attracted to localities where the most extensive laboratory equipment exists. So, one way and another, results are most likely to come from the major countries with the biggest undertakings. Thus the nuclear facilities have a direct bearing on the scope for electrogravitics work.

The OEEC report in January made the following points: -

The U.S. has six to eight entirely different types of reactor in operation and many more under construction. Europe has now two different types in service.

The U. S. has about 30 research reactors plus four in Britain, two in France.

The U. S. has two nuclear-powered marine engines. Europe has none, but the U.K. is building one.

Isotope separation plants for the enrichment of uranium in the U.S. are roughly 11 times larger than the European plant in Britain.

Europe's only heavy water plant (in Norway) produces somewhat less than one-twentieth of American output.

In 1955 the number of technicians employed in nuclear energy work in the U.S. was about 15,000; there are about 5,000 in Britain, 1,800 in France, and about 1,000 in the rest of Europe. But the working party says that pessimistic conclusions should not be drawn from these comparisons. European nuclear energy effort is unevenly divided at the moment, but some countries have notable achievements to their credit and important developments in prospect. The main reason for optimism is that, taken as a whole, "Europe's present nuclear effort falls very far short of its industrial potential".

Though gravity research, such as there has been of it, has been unclassified, new principles and information gained from the nuclear research facilities that have a vehicle application is expected to be withheld.

The heart of the problem to understanding gravity is likely to prove to be the way in which the very high energy sub-nuclear particles convert something, whatever it is, continuously and automatically into the tremendous nuclear and electromagnetic forces. Once this key is understood, attention can later be directed to finding laboratory means of duplicating the process and reversing its force lines in some local environment and returning the energy to itself to produce counterbary. Looking beyond it seems possible that gravitation will be shown to be a part of the universal electro-magnetic processes and controlled in the same way as a light wave or radio wave. This is a synthesis of the Einstein and Hlavaty concepts. Hence it follows that though in its initial form the mechanical processes for countering gravity may initially be massive to deal with the massive forces involved, eventually this could be expected to form some central power generation unit. Barycentric control in some required quantity could be passed over a distance by a form of radio wave. The prime energy source to energise the waves would of course be nuclear in its origins.

It is difficult to say which lines of detailed development being processed in the immediate future is more likely to yield significant results. Perhaps the three most promising are: first, the new attempt by the team of men led by Chamberlain working with the Berkeley bevatron to find, the anti-neutron, and to identify more of the characteristics of the anti-proton* and each of the string of high energy particles that have been discovered during recent operation at 6.2 bev.

*The reaction is as follows: protons are accelerated to 6.2 bev, and directed at a target of copper. When the proton projectile hits a neutron in one of the copper atoms the following emerge: the two original particles (the projectile and the struck neutron) and a new pair of

particles, a proton and anti-proton. The anti-proton continues briefly until it hits another proton, then both disappear and decay into mesons.

A second line of approach is the United States National Bureau of Standards program to pin down with greater accuracy the acceleration values of gravity. The presently accepted figure of 32.174 feet per second per second is known to be not comprehensive, though it has been sufficiently accurate for the limited needs of industry hitherto. The NBS program aims at re-determining the strength of gravity to within one part of a million. The present method has been to hold a ball 16 feet up and chart the elapsed time of descent with electronic measuring equipment. The new program is based on the old, but with this exceptional degree of accuracy it is naturally immensely more difficult and is expected to take 3 years .

A third promising line is the new technique of measuring high energy particles in motion that was started by the University of California last year. This involves passing cosmic rays through a chamber containing a mixture of gas, alcohol and water vapour. This creates charged atoms, or positive ions, by knocking electrons off the gas molecules. A sudden expansion of the chamber results in a condensation of water droplets along the track which can be plotted on a photographic plate. This method makes it easier to assess the energy of particles and to distinguish one from the other. It also helps to establish the characteristics of the different types of particle. The relationship between these high energy particles, and their origin, and characteristics, have a bearing on electrogravitics in general.

So much of what has to be discovered as a necessary preliminary to gravity is of no practical use by itself. There is no conceivable use, for instance, for the anti-proton, yet its discovery even at a cost of \$9-million is essential to check the mathematics of the fundamental components of matter. Similarly it is necessary to check that all the nuclear ghosts that have been postulated theoretically do in fact exist. It is not, moreover, sufficient, as in the past only to observe the particles by radiation counters. In each instance a mechanical maze has to be devised and attached to a particle accelerator to trap only the particle concerned. Each discovery becomes a wedge for a deeper probe of the nucleus. Many of the particles of very high energy have only a fleeting existence and collisions that give rise to them from bevatron bombardment is a necessary prerequisite to an understanding of gravity. There are no shortcuts to this process.

Most of the major programs for extending human knowledge on gravity are being conducted with instruments already in use for nuclear research and to this extent the cost of work exclusively on gravitational examinations is still not of major proportions. This has made it difficult for aviation to gauge the extent of the work in progress on gravity research.

* * *

CONCLUSIONS

1. No attempts to control the magnitude or direction of the earth's gravitational force have yet been successful. But if the explanation of gravity is to be found in the as yet undetermined characteristics of the very high energy particles it is becoming increasingly possible with the bevatron to work with the constituent matter of gravity. It is therefore reasonable to expect that the new bevatron may, before long, be used to demonstrate limited gravitational control.
2. An understanding and identification of these particles is on the frontiers of human knowledge, and a full assessment of them is one of the major unresolved puzzles of the nucleus. All associated problem is to discover a theory to account for the cosmic and quantum relations of gravity, and a theory to link the gravitational constant with the other three dimensionless constants.
3. Though the obstacles to an adequate grasp of microphysics still seem formidable, the transportation rewards that could follow from electrogravitics are as high as can be envisaged.

In a weightless environment, movement with sharp-edged changes of direction could offer unique maneuverability.

4. Determination of the environment of the anti-proton, discovery of the anti-neutron and closer examination of the other high energy particles are preliminaries to the hypothesis that gravity is one aspect of electromagnetism that may eventually be controlled like a wave. When the structure of the nucleus becomes clearer, the influence of the gravitational force upon the nucleus and the nature of its behaviour in space will be more readily understood. This is a great advance on the Newtonian concept of gravity acting at a distance.

5. Aviation's role appears to be to establish facilities to handle many of the peripheral and statistical investigations to help fill in the background on electrostatics.

6. A distinction has to be made between electrostatic energy for propulsion and counterbary. Counterbary is the manipulator, of gravitational force lines; barycentric control is the adjustment to such manipulative capability to produce a stable type of motion suitable for transportation.

7. Electrostatic energy sufficient to produce low speeds (a few thousand dynes) has already been demonstrated. Generation of a region of positive electrostatic energy on one side of a plate and negative on the other sets up the same lift or propulsion effect as the pressure and suction below and above a wing, except that in the case of electrostatic application no airflow is necessary.

8. Electrostatic energy sufficient to produce a Mach 3 fighter is possible with megavolt energies and a k of over 10,000.

9. k figures of 6,000 have been obtained from some ceramic materials and there are prospects of 30,000.

10. Apart from electrogravitics there are other rewards from investment in electrostatic equipment. Automation, autonetics and even turbine development use similar laboratory facilities.

11. Progress in electrogravitics probably awaits a new genius in physics who can find a single equation to tie up all the conflicting observations and theory on the structure and arrangement of forces and the part the high energy particles play in the nucleus. This can occur any time, and the chances are improved now that bev. energies are being obtained in controlled laboratory conditions.

* * *

A P P E N D I X I

EXTRACTS FROM AVIATION REPORT

ANTI-GRAVITATION RESEARCH

The basic research and technology behind electro-anti-gravitation is so much in its infancy that this is perhaps one field of development where not only the methods but the ideas are secret. Nothing therefore can be discussed freely at the moment. Very few papers on the subject have been prepared so far, and the only schemes that have seen the light of day are for pure research into rigs designed to make objects float around freely in a box. There are various radio applications, and aviation medicine departments have been looking for something that will enable them to study the physiological effects on the digestion and organs

of an environment without gravity. There are however long term aims of a more revolutionary nature that envisage equipment that can defeat gravity.

Aviation Report 20 August 1954

MANAGERIAL POLICY FOR ANTI-GRAVITICS

The prospect of engineers devising gravity-defeating equipment - or perhaps it should be described as the creation of pockets of weightless environments - does suggest that as a long term policy aircraft constructors will be required to place even more emphasis on electro-mechanical industrial plant, than is now required for the transition from manned to unmanned weapons. Anti-gravitics work is therefore likely to go to companies with the biggest electrical laboratories and facilities. It is also apparent that anti-gravitics, like other advanced sciences, will be initially sponsored for its weapon capabilities. There are perhaps two broad ways of using the science - one is to postulate the design of advanced type projectiles on their best inherent capabilities. And the more critical parameters (that now constitutes design limitation) can be eliminated by anti-gravitics. The other, which is a longer term plan, is to create an entirely new environment with devices operating entirely under an anti-gravitic envelope.

Aviation Report 24 August 1954

THE GREATER THE EASIER

Propulsion and atomic energy trends are similar in one respect: the more incredible the long term capabilities are, the easier it is to attain them. It is strange that the greatest of nature's secrets can be harnessed with decreasing industrial effort, but greatly increasing mental effort. The Americans went through the industrial torture to produce tritium for the first thermonuclear experiment, but later both they and the Russians were able to achieve much greater results with the help of lithium 6 hydride. The same thing is happening in aviation propulsion: the nuclear fuels are promising to be tremendously powerful in their effect, but excessively complicated in their application, unless there can be some means of direct conversion as in the strontium 90 cell. But lying behind and beyond the nuclear fuels is the linking of electricity to gravity which is an incomparably more powerful way of harnessing energy than the only method known to human intellect at present - electricity and magnetism. Perhaps the magic of barium aluminum oxide will perform the miracle in propulsion that lithium 6 hydride has done in the fusion weapon. Certainly it is a well-known material in dielectrics, but when one talks of massive-k, one means of course five figures. At this early stage it is difficult to relate k to Mach numbers with any certainty but realizable k can, with some kinds of arithmetic, produce astounding velocities. They are achievable, moreover, with decreasing complexity, indeed the ultimate becomes the easiest in terms of engineering, but the most hideous in terms of theory. Einstein's general theory of relativity is, naturally, and important factor, but some of the postulates appear to depend on the unified field theory, which cannot yet be physically checked because nobody knows how to do it. Einstein hopes to find a way of doing so before he dies.

Aviation Report 31 August 1954

GRAVITICS FORMULATIONS

All indications are that there has still been little cognizance of the potentialities of electrostatic propulsion and it will be a major undertaking to re-arrange aircraft plants to conduct large-scale research and development into novel forms of dielectric and to improve condenser efficiencies and to develop the novel type of materials used for fabrication of the primary structure. Some extremely ambitious theoretical programs have been submitted and work towards realization of a manned vehicle has begun. On the evidence, there are far more definite indications that the incredible claims are realizable than there was for instance, in supposing that uranium fission would result in a bomb. At least it is known, proof positive, that motion, using surprisingly low k, is possible. The fantastic control that again is feasible, has not yet been demonstrated, but there is no reason to suppose the arithmetic is faulty,

especially as it has already led to a quite brisk example of actual propulsion. That first movement was indeed an historic occasion, reminiscent of the momentous day at Chicago when the first pile went critical, and the phenomenon was scarcely less weird. It is difficult to imagine just where a well organized examination into long term gravitics prospects would end. Though a circular planform is electrostatically convenient, it does not necessarily follow that the requirements of control by differential changes would be the same. Perhaps the strangest part of this whole chapter is how the public managed to foresee this concept, though not of course the theoretical principles that gave rise to it, before physical tests confirmed that the mathematics was right. It is interesting also that there is no point of contact between the conventional science of aviation and the New: it is a radical offshoot with no common principles. Aerodynamics, structures heat engines, flapping controls, and all the rest of aviation is part of what might be called the Wright Brothers era - even the Mach 2.5 thermal barrier piercers are still Wright Brothers concepts, in the sense that they fly, and they stall, and they run out of fuel after a short while, and they defy the earth's pull for a short while. Thus this century will be divided in two parts - almost to the day. The first half belonged to the Wright Brothers who foresaw nearly all the basic issues in which gravity was the bitter foe. In part of the second half, gravity will be the great provider. Electrical energy, rather irrelevant for propulsion in The first half becomes a kind of catalyst to motion in the second half of the century.

Aviation Report 7 September 1954

ELECTRO-GRAVITICS PARADOX

Realization of electro-static propulsion seems to depend on two theoretical twists and two practical ones. The two theoretical puzzles are: first, how to make a condenser the centre of a propulsion system, and second is how to link the condenser system with the gravitational field. There is a third problem, but it is some way off yet, which is how to manipulate kva for control in all three axes as well as for propulsion and lift. The two practical tricks are first how, with say a Mach 3 weapon in mind, to handle 50,000 kva within the envelope of a thin pancake of 35 feet in diameter and second how to generate such power from within so small a space. The electrical power in a small aircraft is more than in a fair sized community the analogy being that a single rocketjet can provide as much power as can be obtained from the Hoover Dam. It will naturally take as long to develop electro-gravitic propulsion as it has taken to coax the enormous power outputs from heat engines. True there might be a flame in the electro-gravitic propulsion system, but it would not be a heat engine - the temperature of the flame would be incidental to the function of the chemical burning process.

The curious thing is that though electro-static propulsion is the antithesis of magnetism,* Einstein's unified field theory is an attempt to link gravitation with electro-magnetism. This all-embracing theory goes on logically from the general theory of relativity, that gives an ingenious geometrical interpretation of the concept of force which is mathematically consistent with gravitation but fails in the case of electro-magnetism, while the special theory of relativity is concerned with the relationship between mass and energy. The general theory of relativity fails to account for electro-magnetism because the forces are proportional to the charge and not to the mass. The unified field theory is one of a number of attempts that have been made to bridge this gap, but it is baffling to imagine how it could ever be observed. Einstein himself thinks it is virtually impossible. However Hlavaty claims now to have solved the equations by assuming that gravitation is a manifestation of electro-magnetism. This being so is all the more incredible that electro-static propulsion (with kva for convenience fed into the system and not self-generated) has actually been demonstrated. It may be that to apply all this very abstruse physics to aviation it will be necessary to accept that the theory is more important than this or that interpretation of it. This is how the physical constants, which are now regarded as among the most solid of achievements in modern physics, have become workable, and accepted. Certainly all normal instincts would support the Einstein series of postulations, and if this is so it is a matter of conjecture where it will lead in the long term future of the electro-gravitic science.

* Though in a sense this is true, it is better expressed in this report than it was here in 1954.

ELECTRO-GRAVITIC PROPULSION SITUATION

Under the terms of Project Winterhaven the proposals to develop electro-gravitics to the point of realizing a mach 3 combat type disc were not far short of the extensive effort that was planned for the Manhattan District.* Indeed the drive to develop the new prime mover is in some respects rather similar to the experiments that led to the release of nuclear energy in the sense that both involve fantastic mathematical capacity and both are sciences so new that other allied sciences cannot be of very much guide. In the past two years since the principle of motion by means of massive-k was first demonstrated on a test rig, progress has been slow. But the indications are now that the Pentagon is ready to sponsor a range of devices to help further knowledge, In effect the new family of TVs would be on the same tremendous scope that was envisaged by the X-1,2,3,4 and 5 and D.558s that were all created for the purpose of destroying the sound barrier - which they effectively did, but it is a process that is taking ten solid years of hard work to complete. (Now after 7 years the X-2 has yet to start its tests and the X-3 is still in performance testing stage). Tentative targets now being set anticipate that the first disc should be complete before 1960 and it would take the whole of the sixties to develop it properly, even though some combat things might be available ten years from now.

* The proposals, it should be added, were not accepted.

One thing seems certain at this stage, that the companies likely to dominate the science will be those with the biggest computers to work out the ramifications of the basic theory. Douglas is easily the world's leader in computer capacity, followed by Lockheed and Convair. The frame incidentally is indivisible from the engine. If there is to be any division of responsibility it would be that the engine industry might become responsible for providing the electrostatic energy (by, it is thought, a kind of flame) and the frame maker for the condenser assembly which is the core of the main structure.

Aviation Report 12 October 1954

GRAVITICS STUDY WIDENING

The French are now understood to be pondering the most effective way of entering the field of electro-gravitic propulsion systems. But not least of the difficulties is to know just where to begin. There are practically no patents so far that throw very much light on the mathematics of the relation between electricity and gravity. There is, of course, a large number of patents on the general subject of motion and force, and some of these may prove to have some application. There is, however a series of working postulations embodied in the original Project Winterhaven, but no real attempt has been made in the working papers to go into the detailed engineering. All that had actually been achieved up to just under a year ago was a series of fairly accurate extrapolations from the sketchy data that has so far been actually observed. The extrapolation of 50 mph to 1,800 mph, however, (which is what the present hopes and aspirations amount to) is bound to be a rather vague exercise. This explains American private views that nothing can be reasonably expected from the science yet awhile. Meanwhile, the NACA is active, and nearly all the Universities are doing work that borders close to what is involved here, and something fruitful is likely to turn up before very long.

Aviation Report 19 October 1954

GRAVITICS STEPS

Specification writers seem to be still rather stumped to know what to ask for in the very hazy science of electro-gravitic propelled vehicles. They are at present faced with having to plan the first family of things - first of these is the most realistic type of operational test rig, and second the first type of test vehicle. In turn this would lead to sponsoring of a combat disk. The preliminary test rigs which gave only feeble propulsion have been somewhat improved, but of course the speeds reached so far are only those more associated with what is attained on the roads rather than in the air. But propulsion is now known to be possible, so it is a matter of feeding enough KVA into condensers with better k figures. 50,000 is a magic figure for the combat saucer - it is this amount of KVA and this amount of k that can be translated into Mach 3 speeds.

Meanwhile Glenn Martin now feels ready to say in public that they are examining the unified field theory to see what can be done. It would probably be truer to say that Martin and other companies are now looking for men who can make some kind of sense out of Einstein's equations. There's nobody in the air industry at present with the faintest idea of what it is all about. Also, just as necessary, companies have somehow to find administrators who know enough of the mathematics to be able to guess what kind of industrial investment is likely to be necessary for the company to secure the most rewarding prime contracts in the new science. This again is not so easy since much of the mathematics just cannot be translated into words. You either understand the figures, or you cannot ever have it explained to you. This is rather new because even things like indeterminacy in quantum mechanics can be more or less put into words.

Perhaps the main thing for management to bear in mind in recruiting men is that essentially electro-gravitics is a branch wave technology and much of it starts with Planck's dimensions of action, energy and time, and some of this is among the most firm and least controversial sections of modern atomic physics.

Aviation Report 19 November 1954

ELECTRO-GRAVITICS PUZZLE

Back in 48 and 49, the public in the U.S. had a surprisingly clear idea of what a flying saucer should, or could, do. There has never been any realistic explanation of what propulsion agency could make it do those things, but its ability to move within its own gravitation field was presupposed from its maneuverability. Yet all this was at least two years before electro-static energy was shown to produce propulsion. It is curious that the public were so ahead of the empiricists on this occasion, and there are two possible explanations. One is that optical illusions or atmospheric phenomena offered a preconceived idea of how the ultimate aviation device ought to work. The other explanation might be that this was a recrudescence of Jung's theory of the Universal Mind which moves up and down in relation to the capabilities of the highest intellects and this may be a case of it reaching a very high peak of perception.

But for the air industries to realize an electro-gravitic aircraft means a return to basic principles in nuclear physics, and a re-examination of much in wave technology that has hitherto been taken for granted. Anything that goes any way towards proving the unified field theory will have as great a bearing on electro-gravitics efforts on the furtherance of nuclear power generally. But the aircraft industry might as well face up to the fact that priorities will in the end be competing with the existing nuclear science commitments. The fact that electro-gravitics has important applications other than for a weapon will however strengthen the case for governments to get in on the work going on.

Aviation Report 28 January 1955

MANAGEMENT NOTE FOR ELECTRO-GRAVITICS

The gas turbine engine produced two new companies in the U.S. engine field and they have, between them, at various times offered the traditional primes rather formidable

competition. Indeed GE at this moment has, in the view of some, taken the Number two position. In Britain no new firms managed to get a footing, but one, Metro-Vick, might have done if it had put its whole energies into the business. It is on the whole unfortunate for Britain that no bright newcomer has been able to screw up competition in the engine field as English Electric have done in the airframe business.

Unlike the turbine engine, electro-gravitics is not just a new propulsion system, it is a new mode of thought in aviation and communications, and it is something that may become all-embracing. Theoretical studies of the science unfortunately have to extend right down to the mathematics of the meson and there is no escape from that. But the relevant facts wrung from the nature of the nuclear structure will have their impact on the propulsion system, the airframe and also its guidance. The airframe, as such, would not exist, and what is now a complicated stressed structure becomes some convenient form of hard envelope. new companies therefore who would like to see themselves as major defence prime contractors in ten or fifteen years' time are the ones most likely to stimulate development. Several typical companies in Britain and the U.S. come to mind - outfits like AiResearch, Raytheon, Plessey in England, Rotax and others. but the companies have to face a decade of costly research into theoretical physics and it means a great deal of trust. Companies are mostly overloaded already and they cannot afford to, but when they sit down and think about the matter they can scarcely avoid the conclusion that they cannot afford not to be in at the beginning.

Aviation Report 6 February 1955

ELECTRO-GRAVITICS BREAKTHROUGHS

Lawrence Bell said last week he thought that the tempo of development leading to the use of nuclear fuels and antigravitational vehicles (he meant presumably ones that create their own gravitational field independently of the earth's) would accelerate. He added that the breakthroughs now feasible will advance their introduction ahead of the time it has taken to develop the turbojet to its present pitch. Beyond the thermal barrier was a radiation barrier, and he might have added ozone poisoning and meteorite hazards, and beyond that again a time barrier. Time however is not a single calculable entity and Einstein has taught that an absolute barrier to aviation is the environmental barrier in which there are physical limits to any kind of movement from one point in space-time continuum to another. Bell (the company not the man) have a reputation as experimentalists and are not so earthy as some of the other U.S. companies; so while this first judgment on progress with electrogravitics is interesting, further word is awaited from the other major elements of the air business. Most of the companies are now studying several forms of propulsion without heat engines though it is early days yet to determine which method will see the light of day first. Procurement will open out because the capabilities of such aircraft are immeasurably greater than those envisaged with any known form of engine.

Aviation Report 15 July 1955

THERMONUCLEAR-ELECTROGRAVITICS INTERACTION

The point has been made that the most likely way of achieving the comparatively low fusion heat needed - 1,000,000 degrees provided it can be sustained (which it cannot be in fission for more than a microsecond or two of time) - is by use of a linear accelerator. The concentration of energy that may be obtained when accelerators are rigged in certain ways make the production of very high temperatures feasible but whether they could be concentrated enough to avoid a thermal heat problem remains to be seen. It has also been suggested that linear accelerators would be the way to develop the high electrical energies needed for creation of local gravitational systems. It is possible therefore to imagine that the central core of a future air vehicle might be a linear accelerator which would create a local weightless state by use of electrostatic processes and turn heat into energy without chemical processes for propulsion. Eventually - towards the end of this century - the linear accelerator itself would not be required and a ground generating plant would transmit the necessary energy for both purposes by wave propagation.

POINT ABOUT THERMONUCLEAR REACTION REACTORS

The 20 year estimate by the AEC last week that lies between present research frontiers and the fusion reactor probably refers to the time it will take to tap fusion heat. But it may be thought that rather than use the molecular and chemical processes of twisting heat into thrust it would be more appropriate to use the new heat source in conjunction with some form of nuclear thrust producer which would be in the form of electrostatic energy. The first two Boeing nuclearjet prototypes now under way are being designed to take either molecular jets, or nuclear jets in case the latter are held up for one reason, or another. But the change from molecular to direct nuclear thrust production in conjunction with the thermonuclear reactor is likely to make the aircraft designed around the latter a totally different breed of cat. It is also expected to take longer than two decades, though younger executives in trade might expect to live to see a prototype

Aviation Report 14 October 1955

ELECTROGRAVITICS FEASIBILITY

Opinion on the prospects of using electrostatic energy for propulsion, and eventually for creation of a local gravitational field isolated from the earth's has naturally polarized into the two opposite extremes. There are those who say it is nonsense from start to finish, and those who are satisfied from performance already physically manifest that it is possible and will produce air vehicles with absolute capabilities and no moving parts. The feasibility of a mach 3 fighter (the present aim in studies) is dependent on a rather large k extrapolation, considering the pair of saucers that have physically demonstrated the principle only a achieved a speed of some 30 fps. But, and this is very important, they have attained a working velocity using a very inefficient (even by to-day s knowledge) form of condenser complex. These humble beginnings are surely as hopeful as Whittle's early postulations.

It was, by the way, largely due to the early references in Aviation Report that work is gathering momentum in the U.S. Similar studies are beginning in France, and in England, some men are on the job full time.

Aviation Report 15 November 1955

ELECTRO-GRAVITICS EFFORT WIDENING

Companies studying the implications of gravitics are said, in a new statement, to include Glenn Martin, Convair, Sperry-Rand, Sikorsky, Bell, Lear Inc. and Clark Electronics. Other companies who have previously evinced interest include Lockheed Douglas and Hiller. The remainder are not disinterested, but have not given public support to the new science - which is widening all the time. The approach in the U.S. is in a sense more ambitious than might have been expected. The logical approach, which has been suggested by Aviation Studies, is to concentrate on improving the output of electrostatic rigs in existence that are known to be able to produce thrust. The aim would be to concentrate on electrostatics for propulsion first and widen the practical engineering to include establishment of local gravity forcelines, independent of those of the earth's to provide unfettered vertical movement as and when the mathematics develops.

However, the U.S. approach is rather to put money into fundamental theoretical physics of gravitation in an effort first to create the local gravitational field. Working rigs would follow in the wake of the basic discoveries. Probably the correct course would be to sponsor both approaches, and it is now time that the military stepped in with big funds. The trouble about the idealistic approach to gravity is that the aircraft companies do not have the men to conduct such work. There is every expectation in any case that the companies likely to find the answers lie outside the aviation field. These would emerge as the masters of aviation in its broadest sense.

The feeling is therefore that a company like A.T. & T. is most likely to be first in this field. This giant company (unknown in the air and weapons fields has already revolutionized modern warfare with the development of the junction transistor and is expected to find the final answers to absolute vehicle levitation. This therefore is where the bulk of the sponsoring money should go.

Aviation report 9 December 1955

APPENDIX II

ELECTROSTATIC PATENTS

(a) American patents still in force.

2,413,391	Radio Corp of America	20-6-42/31-12-46	Power Supply System
2,417,452	Raytheon Mfg. Co.	17-1-44/18- 3-47	Electrical System
2,506,472	W.B. Smits	3-7-46Holl/ 2- 5-50	Electrical Ignition Apparatus
2,545,354	G.E.C.	16-3-50/13 3-51	Generator (=Engl.P.676,953)
2,567,373	Radio Corp of America	10-6-49/11- 9-51	El'static Generator
2,577,446	Chatham Electronics	5-8-50/ 4-12-51	El'static Voltage Generator
2,578,908	US-Atomic Energy C.	26-5-47/18-12-51	El'static Voltage Generator
2,588,513	Radio Corp of America	10-6-49/11- 3-52	El'static High-Voltage Generator
2,610,994	Chatham Electronics	1-9-50/16- 9-52	El'static Voltage Generator
2,662,191	P.Okey	31-7-52/8 -12-53	El'static Machine
2,667,615	R. G. Brown	30-1-52/26- 1-54	El'static Generator
2,671,177	Consolidated Eng.Corp	4-9-51/2 - 3-54	El'static Charging App's.
2,701,844	H.R. Wasson	8-1250/ 8- 2-55	El'static Generator of Electricity
2,702,353	US-Navy	17-7-52/15- 2-55	Miniature Printed Circuit Electrostatic Generator

(b) British Patents still in force

651,153	Metr.-Vickers Electr. Co	20-5-48/14- 3-51	Voltage Transformation of electrical energy
651,295	Ch.F.Warthen Sr (U.S.A.)	6-8-48/14- 3-51	Electrostatic AC Generator
731,774	"Licentia"	19-9-52 & 21-11- 53Gy/15- 6-55	El'static High-Voltage Generator

(c) French Patents still in force

53,363	H.Chaumat	19-7-32/13-10-33	Moteur electrostatique utilisant l'energie cinetique d'ions gazeux

749,832	H.Chaumat	24-1-33/29- 7-33	Machine electrostatique a excitation independante
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The following patents derive from P.Jolivet (Algiers), marked "A" and from N.J.Felici, E.Gartner (Centre National des Recherches Scientifique - CRNS -) later also by R.Morel, M. Point etc. (S.A. des Machines Electrostatiques -(SAMES-) and of Societe d' Appareils de Controle et d'Equipment des Moteurs -SACEM-), marked "G" (because the development was centered at the University Grenoble.

1. MARK OF APPLICANT
2. APPLICATION DATE
3. ENGLAND
3. AMERICA
4. FRANCE
5. GERMANY
6. TITLE

1	2	3	4	5	6	7
G	8-11-44	637,434	2,486,140	993,017	860,649	Electrostatic Influence Machine
	14- 8 45			56,027		
G	17-11-44	639,653	2,523,688	993,052	815,667	Electrostatic Influence Machine
A	28- 2-45			912,444		Inducteurs de Machines el'static
G	3- 3-45	643.660	2,519,554	915,442	852,586	El'static Machines
A	8- 6-45			915,929		Machines electrostatiques a flasques
A	16- 8-45			918,547		Generatrice el'statique
G	20- 9-45			998,397	837,267	Electrostatic Machines
	21- 9-45			56,356		
A	4- 2-46			923,593		Generatrice el'statique
G	17- 7-46	643,579	2,530,193	1002,031	811,595	Generating Machines
G	20- 2-47	671,033	2,590,168			Ignition Device
G	21-3 -47	655,474	2,542,494	944,574	860,650	El'static Machines
		Re-23,560				
G	6- 6-47	645,916	2,522,106	948,409	810,042	El'static Machines
A	16- 6-47			947,921		Generatrice el'statique
G	16- 1-48	669,645	2,540,327	961,210	810,043	El'static Machines
G	21- 1-49	669,454	2,617,976	997,991	815,666	El'static Machines
G	7- 2-49	675,649	2,649,566	1010,924	870,575	El'static Machines
G	15- 4-49	693,914	2,604,502	1011,902	832,634	Commutators for electrical machine
G	9-11-49	680,178	2,656,502	1004,950	850.485	El'static Generate
	20- 2-50					
G	29-11-50	702,421		1028,596		El'static Generate
	29- 2-51					
G	21-11-51	719,687		1051,430	F10421	El'static Machines
G	20-8-52	731,773	2,702,869		938,198	El'static Machines

G	6-11-52	745,489				El'static Generator
G	12- 2-53	745,783				Rotating El'static Machines
G	8- 1-52	715.010	2,685,654			Rotating El'static Machines producing a periodical discharge
		Appl'n. No.				
G	27-2-54	5726/55				El'static Machines
G	8-3-54	6790/55				El'static Machines
G	28-1-55	2748/56				El'static Machines

NOTE:- ALL THE LISTED PATENTS ARE STILL IN FORCE

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CONTEXT FROM ORIGINAL DOCUMENT

(p45)

(PUBLIC DOMAIN) - 25 February 1956 — The Special Weapons Study Unit of Aviation Studies International, Ltd. delivers an examination of electrogravitics systems (the link between electromagnetism and gravity to produce antigravity) to Wright-Patterson Air Force Base. The report refers to a Project Winterhaven that suggested a "saucer" could create a local gravitational field and serve as a USAF interceptor with Mach 3 capability. It was declassified in 1995. Winterhaven was allegedly based on the designs of Thomas Townsend Brown.

It states Glenn Martin Co. (see 20 November 1955) could be achieved in six years but it would need a "Manhattan Project" environment to achieve it; Clarke Electronics, General Electric, Bell Labs, Convair, Lear Inc., Sperry-Rand, Curtiss-Wright, Lockheed, Boeing and North American are all mentioned as working on antigravity "rigs."

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