metrologia

International Journal of Scientific Metrology

Internationale Zeitschrift für wissenschaftliche Metrologie

Journal international de Métrologie scientifique

Published under the Auspices of the International Committee of Weights and Measures

Supplement to Volume 24 1987

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Springer International

124 ISSN 0026-1394 MTRGAU 24 (Suppl.) 1–56 (1987)

June 1987

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Metrologia 24 (Suppl.) 1 – 56 (1987)

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The Newtonian Gravitational Constant

An Index of Measurements

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Foreword

So far as our experimental knowledge extends at present, the gravitational attraction between bodies is in accordance with general relativity. In all but the strongest fields, the law of force is the Newtonian inverse square law and the gravitational attraction of a body is proportional to its inertial mass. All bodies follow geodesic paths in four dimensional space, whatever their chemical constitution, so that gravitation appears to be a strictly geometrical phenomenon. Whether or not that is a correct statement has very far reaching implications for the nature of the physical world, and from Newton's day onwards, there have been many attempts to test the validity of Newton's law of gravitation. Despite the most careful analyses, it seems there is no deviation from it that can be found in celestial mechanics. The most careful and precise experiments on gravitation are those that establish the validity of the weak equivalence principle. Other very sensitive experiments have, in the past, excluded a range of effects, such as any of temperature, or crystal structure, or gravitational shielding. The status of experimental tests of the inverse square law is less satisfactory, while the scatter of the best measured values of the constant of gravitation itself is still considerable. The results of experiments on the weak equivalence principle and the inverse square law have recently been put to question again by the suggestion that there is a "fifth force" between baryons that would look like a massive component of gravitation, showing deviations from weak equivalence and the inverse square law and it is claimed that such deviations can be detected.

There is then considerable interest in gravitation at the present time, with many experiments planned or under way.

Experiments on gravitation are difficult, and a great deal of work done in the past, some of it very careful and still valuable, is rather inaccessible.

For all these reasons, it is most helpful to have the comprehensive Index that Dr. Gillies has compiled, and the brief but valuable summaries of the main lines of experiment and their results that he has included. The earlier edition was most useful and one can be none other than very grateful for a new version. To Dr. Gillies and to the Bureau International des Poids et Mesures, our warmest thanks are due.

A. H. Cook, F.R.S.

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* Formerly with the Bureau International des Poids et Mesures where most of this work was done

Abstract. The Newtonian Gravitational Constant, G, has probably been measured more often but, interestingly, with less precision than any other physical constant of fundamental importance. In an effort that has spanned more than a century to connect gravitation to the other forces of nature, over 200 experiments on G have been completed and reported; but many of them have not been reported in what would now be considered to be the open literature. This paper* is a third, more complete attempt to carry MacKenzie's and Poynting's bibliographies forward from the 1800's to the present; and thereby include as many as possible of the experimental results on G that have been obtained since 1900.

I. Introduction

If one were to catalogue the tools of precision measurement, an unusually high number of the listings would claim as their genesis the precision measurement of the Newtonian Gravitational Constant, herein simply referred to as G. These tools would include the torsion balance, the optical lever, the quartz fiber, synchronous detection techniques, ultra-high-precision rotations and many others. Yet G stands alone as the only fundamental constant currently known to little better than one part in a thousand although there are three measurements claiming accuracies of one part in ten thousand. In parallel with these efforts to measure the absolute value of G, there has also been a wide variety of experiments aimed at linking the gravitational force to the other forces of nature. All such efforts to date have had the striking result of demonstrating that gravity, indeed, stands alone – the last of the great classical mechanisms – in spite of its modernized presentation via general relativity.

Classical gravitational physics has been like this, and foreseeably will continue to be like this. The reason why is that, to this date, no one has succeeded in isolating sufficiently well the gravitational interaction between laboratory masses to the point where other disturbing forces or experimental uncertainties do not dominate the measurement, or at least mask other phenomena that might be expected to occur.

It was nevertheless interesting to catalogue the large body of work done already in the hope that a thorough listing of the experimental facts concerning our knowledge of G will stimulate future work on this constant and the force that it governs.

Part of the motivation for this paper lies in the fact that much of the work on G was reported obscurely even though most experiments have been carefully designed and completed. It was, therefore, a challenge to extract from various libraries, archives and private collections the existing data that, when collectively viewed, will help to focus attention on just exactly what has been done and, more importantly, what has *not* been done in this field.

This work is meant to be a bibliography and, at present, only that. Owing to the unusually large number of references cited, any thorough discussion of all the results would have taken up more space than was available here. Nevertheless, there is a small amount of annotation provided in the following pages for each of the fourteen sections of the bibliography. The areas into which the papers have been classified are listed below:

1. Measurements of the absolute value of G and reports of important subsidiary technology.
2. Comments and reviews of measurements of G.
3. Measurements of gravitational permeability, absorption and shielding.
4. Measurements of the local directive action of the gravitational force.
5. Measurements of the dependence of G on the physical state of masses.
6. Measurements of the dependence of G on the chemical state of masses.
7. Measurements of the dependence of G on temperature.
8. Measurements of the dependence of G on the radioactivity of masses.

* This is the third version of this Index. The second was issued by the Bureau International des Poids et Mesures as Rapport BIPM-83/1

9. Measurements of the dependence of G on the electromagnetic energy content of masses.
10. Measurements of the dependence of G on inter-mass spacing.
11. Measurements of the dependence of G on time.
12. Measurements of spontaneous matter creation (related to 11).
13. Measurements of the dependence of G on the state of quantization of the test masses.
14. Measurements of the anisotropies of G and of inertial masses.

There are over 1200 references cited in these 14 sections. There is some duplication, as a few of the papers contain two or more experimental results each in a different area. Duplicate listings constitute about 5% (or less) of the total, however. The references are listed alphabetically in each section with a chronological sub-listing for each author in each section. Abbreviations for the journal titles follow the American Institute of Physics *Style Manual* wherever possible. For those journals not listed there, the abbreviations in the ISI* *Current Contents* indexes have been used. Those listings that have the name(s) of the author(s) marked with an asterisk have not been consulted at the time of this writing. References to entries in the various abstracting journals have not been given except for a few special cases where the abstracted article was judged to be published obscurely.

Not all of the listings in the Mackenzie (1900) and Poynting (1894) bibliographies were repeated here. Some, like those referring to the "Fr. Bertier" Controversy of the late 1700's/early 1800's, have little scientific merit and were omitted.

Sections 11 and 12 contain several references to instrumental papers in addition to those actually quoting significant results. In particular, the efforts at Princeton University, Massachusetts Institute of Technology and the University of Virginia are listed in detail.

Finally, as of this date, there are three new experimental thrusts in this field which have just recently begun. These are the search for a spin dependence in the gravitational force, the search for a fifth force in nature, and the measurements of the force of gravity on antimatter. When the experimental investigations in these areas have had time to develop, the appropriate results will be included in updates in this index.

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II. Experimental Studies and Critical Analyses of *G*

1. Measurements of the Absolute Value of G and Reports of Important Subsidiary Technology

The history of the measurement of the universal gravitational constant begins with geophysical studies of a related physical quantity: the mean density of the earth. These efforts started with attempts to measure the attraction of individual mountains and measurements of strata of the earth's crust as a function of depth in various mines, and they are continuing with measurements of the attraction of layers of water in large level-controllable lakes and in the oceans.

Chronologically, the torsion-balance methods came next, and these gave the most reliable results until the advent of the "torsion-pendulum" technique. The balance-beam methods were studied during the late 1800s, and today all three of these methods are being developed in experiments aimed at accuracies of one in 10^5.

Numerous miscellaneous methods have also been developed. These include resonant torsion pendulums, vertical pendulums, near-zone excitation of gravity-wave detectors, and long-period horizontal pendulums. There have also been several proposals for satellite determinations of G, but so far no such measurements have actually been made.

The early works on G, particularly those of Cavendish, Reich and Baily, have been reviewed frequently and the principal papers of these workers are summarized and paraphrased in most undergraduate textbooks on physics. There are, however, about 60 other determinations of G that are in the open literature. Some of these are well known too, particularly those of Boys, Poynting, Braun, Heyl and the Beams-Deslattes-Luther-Towler collaboration between the University of Virginia and the U.S. National Bureau of Standards.

Of the latest works, there are three that claim accuracies near one part in ten thousand. They are summarized in Table 1. Unfortunately, all of these results are mutually exclusive given the quoted errors. Therefore we must conclude that

Table 1

Author	Year	Experimental technique	$(G \pm \Delta G) \times 10^{11}$ $m^3\,kg^{-1}\,s^{-2}$
Facy, Pontikis	1972	Resonant pendulum	6.6714 ± 0.0006
Sagitov et al.	1979	Torsion pendulum	6.6745 ± 0.0008
Luther, Towler	1982	Torsion pendulum	6.6726 ± 0.0005

Table 2.

Author	Year	Experimental technique	$(G \pm \Delta G) \times 10^{11}$ $m^3\,kg^{-1}\,s^{-2}$
Preston	1895	Pendulum decrement	7.16
Barus	1922	Torsion balance	6.609 ± 0.020
Stern	1928	Resonant balance	6.6 ± 0.5
Renner	1974	Torsion pendulum	6.670 ± 0.008
Karagioz et al.	1976	Torsion pendulum	6.668 ± 0.002
Koldewyn, Faller	1976	Torsion pendulum	6.57 ± 0.17
Spero	1979	Nulled torsion balance	6.70 ± 0.19
Page, Geilker	1981	Torsion balance	6.1 ± 0.4
Karagioz et al.	1981	Torsion pendulum	6.5912 ± 0.0016
Speake	1983	Beam balance	6.64 ± 0.24
Oelfke	1984	Torsion balance	6.7 ± 0.2

the value of G is not, in fact, well established at the 10^{-4} level.

All uncertainties quoted in Table 1 as well as that in the CODATA value below represent one standard deviation.

Even if ultimately measured in a drag-free satellite, where external horizontal gravity gradients would not influence the balance, measurements of G would still be limited by the uncertainties arising from density gradients in the materials used. This would probably occur somewhere between the 10^{-5} and 10^{-6} level. At that point, a totally different approach to the measurement of G will become necessary.

The 1986 CODATA value, assigned by E. R. Cohen and B. N. Taylor, is

$$G = (6.67259 \pm 0.00085) \times 10^{-11}\,m^3\,kg^{-1}\,s^{-2}\,.$$

Mills (1979 – see Section 10) has tabulated the results of the 22 most often cited measurements of G. There are several other works which are less well known but important nonetheless, and the results from these are entered in Table 2. The most recent experiments listed there should be considered as work in progress, and not as final results. Also, some of these measurements were not directed at G itself but at a search for some variation in G, with the quoted result being a by-product. As a rather interesting aside, it should be noted that, since so many of the earliest measurements (those by Cavendish, Reich, Baily, among others) were done for the purpose of determining the mean density of the earth, this motivation has remained the classic justification for undertaking measurements of G. With a knowledge of the earth's density and its volume, one may estimate its total mass, M_e, in kilograms. More recently, satellite ranging experiments have given us the "geocentric" gravitational constant directly: $G_g = GM_e$. The latest of these experiments, Ferrari et al. (1980), has an uncertainty of only about 7×10^{-8}. This means that any increased accuracy in our knowledge of G will automatically give us M_e with a corresponding precision, and vice versa. A few of the recent measurements are catalogued in Table 3.

2. *Comments and Reviews of Measurements of G*

There are four thorough reviews of the measurements of G: two dating to the late 1800s and two more recent ones. Poynting and, later, MacKenzie summarized the contemporary knowledge of G and, for that matter, all of gravitational physics, in books printed in 1894 and 1900, respectively. Sagitov (1969) recently published a similar work on G, although he omitted many references to experiments probably judged by him to be of secondary importance. Most recently, de Boer (1984) has contributed a review article which catalogues the recent major experiments and presents the results and uncertainties together on easily readable graphs. There are several other reviews of the experiments, and these are listed in the bibliography. It should be mentioned that the article on "Gravitation" in each successive edition of the Encyclopedia Britannica contains interesting and relatively thorough sections on G that are very useful.

In addition to the review articles on G, there are a large number of papers, both old and new, that comment on or discuss certain measurements

Table 3.

Author	Year	Satellite	$(G_g \pm \Delta G_g)$ $(km)^3\,s^{-2}$
Esposito	1979	Viking I	398,600.5 ± 0.1
Esposito	1979	Viking II	398,600.65 ± 0.20
Martin, Oh	1979	ATS 6	398,600.36 ± 0.12
Ferrari et al.	1980	Lunar Orbiter 4	398,600.461 ± 0.026

of G, propose new measurement techniques, or analyze probable experimental limitations. Some of these are worth consulting, since errors have occasionally appeared in the main papers of the principal investigators. The titles of the papers in this section of the bibliography usually indicate the relevance to a certain experiment or class of experiments.

3. Measurements of Gravitational Permeability, Absorption and Shielding

Although not widely known, one of the most thoroughly researched aspects of gravitational physics is the question of the existence of a gravitational analogue to magnetic permeability. The pursuit of this question, i.e., the dependence of G on the density of the matter intervening between the interacting masses, began with a null result in the late 1800s. It continued until recent times, always with null results, but with ever-increasing accuracy. We now know that if gravitational energy is, in fact, absorbed by any intervening material, it occurs at a level such that, when measured in terms of G, the result is $(\Delta G/G)_{\text{absorp.}} \leqq 10^{-16}$. Some theoretical analyses establish a lower limit several orders of magnitude below this, too.

At first these measurements were made by employing a Cavendish balance with a cylindrical screen separating the suspended dumb-bell from the attracting masses. Each screen was made of a different type of material and all the materials had different densities. The screens were sequentially changed and the measurements of G subsequently made were analyzed for a resulting effect. Later, Majorana began a long series of experiments using a balance-beam and claimed to have found a result at the 10^{-11} level, but subsequent work by himself and others disproved this. The most sensitive measurements have been made in recent times by several workers studying the period shift in horizontal pendulums during a total solar eclipse. In every case, however, the results have been null except for the results of Allais and, later, Saxl and Allen which are seldom discussed.

Unless a new theory predicts a permeability effect substantially different from that empirically sought so far, it is difficult to see where the motivation would arise for new experiments in this area. This is especially so since recent gravitational analogues of electromagnetism predict that the "gravitational permeability of free space" is only $\frac{16\pi G}{c^2} \approx 10^{-26}$ m/kg (Forward 1961), a very small effect indeed!

4. Measurements of the Local Directive Action of the Gravitational Force

Since so many properties of crystalline materials depend upon the direction of observation (e.g. refractive index, local density distribution, thermal conductivity, etc.), it seemed reasonable to question the constancy of G within crystalline materials as well. This was first done by MacKenzie, then later by Poynting, although no anisotropy in the value of G was found in either case at $\approx 10^{-3}$ and 10^{-4} levels, respectively. Heyl did an exhaustive experiment in this area in 1924 and, by weighing crystals from each of the five non-isometric groups, was able to put a limit of $(\Delta G/G)_{\text{anisot.}} \approx 10^{-9}$, thereby effectively eliminating any doubt about it.

It has been suggested that one should not expect to find such anisotropies in general because they would lead to a violation of conservation of momentum. Nevertheless, the weakness of the gravitational force and the singular properties of some crystals made this, temporarily at least, an attractive area of research.

5. Measurements of the Dependence of G on the Physical State of Masses

This category is a rather general one, although it is possible to classify various types of experiments within it. Specifically, there have been measurements of G involving test masses and attracting masses of various geometrical shapes; for example, spheres, cylinders, rods, rings, and irregular masses have been used. In fact, a cylindrical configuration having the sphere-like field of a point source is presently under study. Attracting and test masses in the gaseous, liquid and solid state have been (or are being) studied, as well as masses which undergo a change of state during the experiment. In all cases, no departure from true constancy of G has been observed, at least within the levels of the experiments' precision. When one considers that the sun, a plasma, and its planets (gas, solid and liquid combinations) have orbits which conform precisely to the inverse square law (with only minor relativistic corrections), it is seen that this law is indeed well obeyed. The references cited here are representative examples of various types of experiments involving gases, liquids and solid masses of various shapes. Some of these citations are listed in other more appropriate sections of the bibliography, too.

6. Measurements of the Dependence of G on the Chemical State of Masses

This area of research is usually interpreted as being a test of the weak equivalence principle of General Relativity, i.e. a determination of the equivalence of gravitational and inertial mass. The various searches for a non-zero Eötvös ratio which test this equivalence are catalogued by Will (1981) and are not included here, except for a few special cases given below.

The earliest measurements in this area involved pendulums of the same mass but made of different materials. Eötvös and his contemporaries expanded this to include torsion balances which had masses of different materials attached to them. His null result has been confirmed by workers at Princeton University, Moscow University and the Joint Institute for Laboratory Astrophysics, Boulder.

Several workers studied the interesting question "Does G vary while the test mass undergoes a chemical reaction?" but, in all cases, equilibrated or reacting, null results have been obtained. This area has not been without controversy, however. C. F. Brush claimed to see a difference in pendulum periods between pendulums made of bismuth and those of zinc. His observations were ultimately explained by his failure to include the buoyancy of air in his calculations.

Although not strictly belonging to this category, the experiment of L. Kreuzer (1966), at Princeton, is included here because it has been interpreted by some as providing evidence for a variation of G over the elements of the periodic table. This claim was subsequently refuted, though.

7. Measurements of the Dependence of G on Temperature

Early in this century there were three attempts to measure with balance-beams a dependence of G on the temperature of the attracting masses. They all produced null results but were nonetheless open to discussion. This was so for two reasons. First, there were well-known difficulties in experiments wherein two masses at different temperatures were used in a high-precision balance; and second, the unknown thermal profile of the earth immediately below the balance would seem to make an exact repetition of the experiment impossible, because any thermal dependence of gravity would presumably affect the earth's field too (and how can one control the temperature of the earth?).

Professor Shaw and his students, therefore, constructed a Boys-type balance in which the attracting masses could be heated. They measured G and analyzed their data in the form $G = G_0(1+\alpha T)$. At first they found $\alpha \approx 10^{-5}\,\mathrm{K}^{-1}$. This result created great interest and several papers were written discussing it. A careful repetition of their original work showed, though, that after removing troublesome convection effects, $\alpha \leqq 2\times10^{-6}\,\mathrm{K}^{-1}$, which effectively settled the issue in the negative. There do not seem to have been any other experiments following this one. Perhaps this is because it was realized that the large temperature difference between the earth and sun, when compared with the much smaller difference between the earth and moon, should have highlighted the existence of the effect. Instead, both orbits serve only to verify that the inverse square law is, in fact, independent of temperature. In questions of this type, however, scale factors may be important; and even though the balance-beam experiments (laboratory scale) in the earth's field produced null results at the 10^{-9} level, Shaw's experiment with isolated gravitational forces (also at laboratory scale) was 2000 times less sensitive. So there may still, perhaps, be effects to be discovered.

The results of all the above experiments are given in Table 4.

Table 4.

Author	Year	Technique	$\lvert\Delta G/G\rvert\,\mathrm{K}^{-1}$
Count Rumford	1785	Beam balance	$\leqq 3.3\times10^{-8}$
Poynting, Phillips	1905	Beam balance	$\leqq 10^{-10}$
Southerns	1906	Beam balance	$\leqq 10^{-8}$
Pettersson	1914	Beam balance	$\leqq 10^{-9}$
Shaw	1916	Torsion balance	$\sim 10^{-5}$
Shaw, Davy	1923	Torsion balance	$\leqq 2\times10^{-6}$

8. Measurements of the Dependence of G on the Radioactivity of Masses

A very interesting area of research in this century has been the search for a connection between gravitation and what we now know to be the nuclear forces. Studies in this area have involved a wide variety of experimental techniques. Several famous physicists have worked in this area, including G. Sagnac, P. Zeeman, A. Compton and J. J. Thomson, each lending his own special expertise to this difficult problem.

Compton, for instance, produced a large and controllable pseudogravitational (centrifugal) field by rotating samples of radium at high speeds. He concluded that this did not affect the radioactivity by more than 10^{-3}. Thomson's uranium-pendulum experiment (carried out in more detail by Southerns) showed no gravitational coupling to the sample's radioactivity at the level of 5×10^{-5}. All other measurements also produced null results, except for that of R. Geigel who claimed to have seen a small weight change in a non-radioactive sample hanging on a sensitive balance when a radium salt sample was placed nearby. He interpreted this as an absorption of radioactivity which led to an increase in the gravitational potential energy of the non-radioactive sample. W. Kaufmann shortly thereafter, however, uncovered a thermal effect which explained the apparent weight change. No one since then has repeated Geigel's experiment.

There is one modern experiment, by Whitaker, which finds a shift in the decay rate of ^{198}Au when subjected to a centrifugal field of 196,000 times gravity at the earth's surface. He gives no evaluation of systematic effects in his measurement system which might mimic such an effect, however.

9. Measurements of the Dependence of G on the Electromagnetic Energy Content of Masses

At the same time as the searches for a radioactivity-gravitation coupling were under way, there was a parallel effort in progress aimed at finding an electromagnetism-gravitation coupling.

These searches typically involved weighing samples of steel and permanent magnets in magnetized and unmagnetized states or charged and uncharged states.

The very much larger size of the electromagnetic forces always makes experiments of this kind very difficult, and careful attention must be paid to the shielding of undesirable electromagnetic couplings to the laboratory which could otherwise make the results ambiguous. In spite of this, null results were always reported.

J. F. Woodward has proposed a repetition (with much higher precision) of the early work of Faraday and Blackett in search of an electrogravitational effect, but it is not clear at this point what a positive result in these experiments would mean in terms of the value of G or the gravitational inverse square law. The reference section of his paper refers the reader to citations of earlier work along that specific line.

10. Measurements of the Dependence of G on Inter-mass Spacing

If a scale dependence other than pure inverse-square-law behavior were found for gravity (in the weak-field limit), such an effect would have a significant impact on current efforts to unify the four forces of nature. Because of the importance of this point, several workers have designed and executed experiments to search for non-Newtonian gravity. Although the results are routinely expressed in terms of a distance dependence for G, i.e., $G(R)$, it is also standard to express such findings in terms of a departure of the force from a R^{-2} dependence of the form $1/R^{2+\delta}$. A unified approach to all these analyses has been made popular by Gibbons and Whiting who plot "allowed" and "disallowed" regions in a two-parameter space established by the scale factor and strength parameters in a Yukawa type of add-on gravitational potential.

The experiments to date have been done on many scales of distance, ranging from 2 cm up to several kilometers. There have been analyses of the free oscillations of the earth in terms of how they might be influenced by a non-zero $G(R)$; and on the still larger scale, the motion of the planets has been seen to confirm the inverse square law to an amazingly high precision (except for the previously-mentioned relativistic corrections).

The majority of the latest experiments have been designed to be high-sensitivity null measurements, although the early work of Mackenzie and, to some extent, that of Long instead involved measurements of the absolute value of G at two or more different mass spacings. While constituting a workable scheme in principle, the absolute measurements are usually burdened with large drifts and metrological difficulties. This sometimes makes their results open to question.

Stacey and his colleagues at the University of Queensland in Australia have undertaken a series of geophysical measurements in search of a non-Newtonian component in the earth's gravitational field. A reanalysis of existing gravity data, Stacey (1983), has motivated them to do this, and their work is currently in progress.

Tests of the superposition principle as applied to gravitational fields also belong in this category. Work in this area was done by G. Luther at the U.S. National Bureau of Standards, and also by P. Czipott and J. Goodkind at the University of California, San Diego.

Finally, reviews of the $G(R)$ measurements have been given by Hoskins et al. (1984) and by Newman (1983) wherein the results have been tabulated and thoroughly discussed. Those interested in the overall status of this type of experimental search for non-Newtonian effects are encouraged to consult these works.

11. Measurements of the Dependence of G on Time

Perhaps no other area of gravitation is of greater interest to theorists and cosmologists than the possibility of variations of G in time. There have been many theories calling for a time-varying G, each having its own implications on the behaviour of matter and radiation at the early moments of the universe.

Here again, the experiments fall into three categories: laboratory, geophysical and astronomical. If such an effect exists, it is agreed that it must be very, very small; probably of the order of $\dot{G}/G \approx 10^{-11}\,\mathrm{a}^{-1}$. Few laboratory tests of any kind have been done at this level, and it is not surprising that the existing laboratory tests of this effect are limited at the level of $10^{-7} \leqq \dot{G}/G \leqq 10^{-8}\,\mathrm{a}^{-1}$. Several experiments with test masses have been proposed for both earth-surface and orbiting laboratories which should be sensitive to the predicted $10^{-11}\,\mathrm{a}^{-1}$ changes, but none has yet been completed.

The geophysical tests have usually involved studies of the expansion of the earth or investigations of a paleobiologic type. While these provide corroborating evidence, they are not usually accepted as hard proof because of the many uncertain factors involved. Wesson's contributions are the most complete in this area, and his book "Cosmology and Geophysics" (1978) should be consulted for a thorough review of geophysical investigations of $\dot{G}/G$.

Van Flandern (1981, 1984) claimed that all three astronomical tests of $\dot{G}/G$ are now yielding similar results; and that $\dot{G}/G \cong -(6 \pm 2) \times 10^{-11}\,\mathrm{a}^{-1}$. Hellings et al., however, reported in 1983 that their solar-system test of $\dot{G}/G$ had a result of $(0.2 \pm 0.4) \times 10^{-11}\,\mathrm{a}^{-1}$, a value consistent with zero. These tests include: (1) lunar laser ranging, (2) radar ranging of the inner planets, and (3) lunar occultation studies and determinations of the moon's orbit. The data from these three experiments have been coming in for several years now and have been carefully analyzed by several workers. The results for $\dot{G}/G$ from each of them have great importance, as each method poses an independent check on the other. Ritter and Gillies (1986) have pointed out, though, that such astronomical tests may be intrinsically null and that a laboratory test is, indeed, needed.

The results from other sources, including laboratory experiments and those derived from cosmological considerations, are listed in Table 5. Although these areas are, at the moment, of secondary importance to the astronomical tests listed above, it is likely that sufficiently accurate

Table 5.

Author	Year	Technique	$\lvert \dot{G}/G \rvert\ \mathrm{a}^{-1}$
Hoffmann	1962	Quartz-pendulum gravimetry	$\leqq 4 \times 10^{-8}$
Curott	1965	Quartz-pendulum gravimetry	$\leqq 6.2 \times 10^{-7}$
Weiss, Block	1965	Quartz-spring gravimetry (drift limit, no firm result quoted)	$\leqq 3.6 \times 10^{-6}$
Stephenson	1967	Reanalysis of Heyl's G measurements	$\sim 10^{-4}$ (periodic annually)
Newton	1968	Earth spin-down	$\sim 10^{-10}$
Morganstern	1972	Flat-space cosmology analysis	$\sim 10^{-11}$
Morganstern	1972	Closed-space cosmology analysis	$\sim 3 \times 10^{-11}$
Eichendorf, Reinhardt	1977	Study of variations in the surface temperature of the earth	$(2.3 \pm 0.6) \times 10^{-11}$
Barrow	1978	Cosmological considerations	$(1.5 \pm 0.7) \times 10^{-12}$
Yang et al.	1979	Analysis of nucleosynthesis data	5×10^{-13}
Lambeck	1979	Earth spin-down	$(2.5 \pm 0.5) \times 10^{-11}$
Lapiedra, Palacios	1981	Planetary-orbit studies	$\leqq 7.5 \times 10^{-13}$
Rothman, Matzner	1982	Reanalysis of nucleosynthesis data	$\leqq 1.7 \times 10^{-13}$

data from all areas will have to be available and in agreement before the existence of a non-zero $\dot{G}/G$ is accepted.

12. Measurements of Spontaneous Matter Creation

Most of the theories that call for a non-zero $\dot{G}/G$ also require the spontaneous creation of matter. This is usually the result of a gauge condition; or is in response to satisfying some phenomenological requirement, such as maintaining constant density in the universe. In a Machian universe, the value of the gravitational constant and processes like matter creation are presumably coupled in such a way that the value (or existence) of one affects the other. Therefore, it seemed appropriate to include the known experimental tests, tests in progress, and proposed tests of this effect, too.

In terms of categories, the $\dot{M}/M$ experiments are classifiable in the same way as the $\dot{G}/G$ experiments. There are substantially fewer of them, and only one laboratory experiment, that of S. Cohen and J. King, has yielded a result which was null at the $\dot{M}/M = 10^{-23}\ \mathrm{s}^{-1}$ level.

13. Measurements of the Dependence of G on the State of Quantization of the Test Masses

There have been two proposals for measuring G in terms of h, the Planck constant. These experiments, if ever done, will be the first direct tests of a quantum structure of the gravitational field. An indirect test by D. Page and C. Geilker has been carried out but the result is disputed.

The force of gravity on fundamental particles has also been measured and, in particular, the behavior of neutron and atomic beams in the field of the earth has been studied. In addition, there is an effort by Melissinos and colleagues to study Newtonian gravity for matter (particles) travelling at relativistic speeds in accelerators.

As progress is made towards a quantized theory of gravity, more experiments of the type in this category will be needed and it may eventually be possible to study the gravitational force on a microscopic basis.

14. Measurements of the Anisotropies of G and of Inertial Mass

The Hughes-Drever class of experiments all produced results which, to very high precision, showed that matter is evenly distributed in the universe. Dicke (1961) showed that they should be null measurements in principle, however.

Somewhat later, this question of large-scale anisotropy in the universe arose again, this time, though, in the context of a variation of G with respect to direction on a universal scale. Warburton and Goodkind (1976) analyzed earth-tide data taken with a superconducting gravimeter and found an effect not inconsistent with such a variation, but could not verify it due to uncertainties in the structure of the earth tides.

A room-temperature, fedback torsion balance has been constructed at the Cavendish Laboratory for a similar investigation, but no results have yet been reported.

Summary of Section II. For the most part, purely theoretical papers that discuss the possibility of variations in G (but do not set limits on it) have not been included in this bibliography. The goal here was to describe instead the "hard facts" so that all workers in the field could more easily assess the state of our knowledge.

The results of the different searches for variations in G are summarized in Table 6. Usually, the

Table 6.

Effect	Author	Year	Result ($\Delta G/G$)
Gravitational permeability or absorption	M. Caputo	1962	$\leqq 6 \times 10^{-16}$
Directive action of gravitational force	P. R. Heyl	1924	$\leqq 10^{-9}$
Dependence of G on physical and/or chemical states of matter	For a review, see C. Will	1981	$\leqq 10^{-12}$
Temperature dependence via a Cavendish balance	P. E. Shaw, N. Davy	1922	$\leqq 2 \times 10^{-6}\ \mathrm{K}^{-1}$
Temperature dependence via a common balance	J. H. Poynting, P. Phillips	1905	$\leqq 10^{-10}\ \mathrm{K}^{-1}$
Gravitation/radioactivity coupling	P. Zeeman	1918	$\leqq 5 \cdot 10^{-8}$
Dependence of G on magnetization of matter	M. G. Lloyd	1909	$\leqq 5 \times 10^{-12}\ \mathrm{gauss}^{-1}$
Dependence of G on electrification of matter	L. Simons	1922	$\leqq 1.2 \times 10^{-7}\ \mathrm{V}^{-1}$
$G(R)$	R. E. Spero et al.	1980	$(1 \pm 7) \times 10^{-5}$
$\dot{G}/G$ (Astronomical)	R. W. Hellings et al.	1983	$(0.2 \pm 0.4) \times 10^{-11}\ \mathrm{a}^{-1}$
$\dot{G}/G$ (Laboratory)	W. F. Hoffmann	1963	$\leqq 4 \times 10^{-8}\ \mathrm{a}^{-1}$
$\dot{M}/M$ (Laboratory)	S. Cohen, J. King	1969	$\leqq 4 \times 10^{-23}\ \mathrm{s}^{-1}$

result claiming highest precision is quoted, although where appropriate a result typical of those in its class is given instead.

Some results entered in Table 6 are dimensionless. In these cases, the authors listed had tried to set limits on some appropriate dimensionless scale factor. Their original results (where necessary) have been interpreted in terms of $\Delta G/G$ for presentation here.

III. Closing

As mentioned previously, this work is meant to be a resource bibliography, not a critical review of the status of each of the various areas treated here. It is hoped that the readers of this bibliography will benefit from the relatively comprehensive listing of references. Further, it is hoped that readers will respond with missing references if possible. This will be the only way that the "holes" can be filled, since the work to bring the bibliography to the present level has been more than one person should attempt alone.

The author will continue to add to this bibliography as more work on G is done in the future and as other previous reports are uncovered and made available. Updates of new material that supplements the existing version will be submitted as regular contributions to "Metrologia".

IV. Acknowledgements

The author is grateful to the editor of "Metrologia", Dr. R. P. Hudson, for his encouragement and assistance in making the publication of this manuscript possible. The Bureau International des Poids et Mesures proved to be the perfect setting for the writting of the early editions of this work, and the extensive holdings of the University of Virginia library, along with the cheerful cooperation of many librarians there, made its completeness possible.

Far too many individuals contributed to this effort to acknowledge individually, but the author is very much indebted to Drs. T. J. Quinn, A. J. F. Metherell, A. Marussi (deceased) and H. de Boer for their support and interest. The original manuscript was patiently typed by Ms. D. Howell and the revision was prepared by Mme. M. Petit. The University of Virginia provided financial support for the production costs, and the author is particularly grateful to the administrations of the School of Engineering and Applied Science and the College of Arts and Science of the University for their assistance.

Bibliography

1. Measurements of the Absolute Value of *G* and Reports of Important Subsidiary Technology

Agafonov, N. I. et al.*: *Forced oscillations of the torsion balance under the action of rocking.* In: *Problems of Gravitational Measurements. Experimental Physics, Ser. B., v. 1.*, Moscow, VNIIOFI, 1971

Agafonov, N. I. et al.*: *Torsion balance oscllation frequencies in the presence of rocking.* In: *Problems of Gravitational Measurements,* Moscow, VNIIOFI, 1974

Airy, G. B.: *Report on the Harton experiments.* Mon. Not. R. Astron. Soc. **15,** 35 – 36 (1855)

Airy, G. B.: *Note respecting the recent pendulum experiments in the Harton colliery.* Mon. Not. R. Astron. Soc. **15,** 46 (1855)

Airy, G. B.: *Report on the Harton experiments.* Mon. Not. R. Astron. Soc. **15,** 125 – 126 (1855)

Airy, G. B.: *Note sur les observations du pendule exécutées dans les mines de Harton pour déterminer la densité moyenne de la terre.* Ann. Chim. Phys. **43,** 381 – 383 (1855)

Airy, G. B.: *Extrait du rapport présenté à la 35e séance anniversaire de la Société Royale Astronomique de Londres par le Conseil de cette société, le 9 février 1855.* Arch. Sci. Phys. Nat. **29,** 177 – 191 (1855)

Airy, G. B.: *On the computation of the effect of the attraction of mountain-masses, as disturbing the apparent astronomical latitude of stations in geodetic surveys.* Philos. Trans. R. Soc. London **145,** 101 – 104 (1855)

Airy, G. B.: *On the computation of the effect of the attraction of mountain-masses as disturbing the apparent astronomical latitude of stations in geodetic surveys.* Mon. Not. R. Astron. Soc. **16,** 42 – 43 (1856)

Airy, G. B.: *Report on the Harton experiments.* Mon. Not. R. Astron. Soc. **16,** 104 (1856)

Airy, G. B.: *Account of pendulum experiments undertaken in the Harton colliery for the purpose of determining the mean density of the earth.* Philos. Trans. R. Soc. London **146,** 297 – 342 (1856)

Airy, G. B.: *Supplement to the 'account of pendulum experiments undertaken in the Harton colliery'; being an account of experiments undertaken to determine the correction for the temperature of the pendulum.* Philos. Trans. R. Soc. London **146,** 343 – 355 (1856)

Airy, G. B.: *Über die in der Kohlengrube von Harton zur Bestimmung der mittleren Dichte der Erde unternommenen Pendelbeobachtungen.* Ann. Phys. (Leipzig) **97,** 599 – 605 (1856)

Airy, G. B.: *Account of pendulum experiments undertaken in the Harton colliery for the purpose of determining the mean density of the earth.* Philos. Mag. **12,** 228 – 231 (1856)

Airy, G. B.: *Supplement to the 'account of pendulum experiments undertaken in the Harton colliery'; being an account of experiments undertaken to determine the correction for the temperature of the pendulum.* Philos. Mag. **12,** 467 – 468 (1856)

Airy, G. B.*: *On the pendulum experiments lately made in the Horton colliery, for ascertaining the mean density of the earth.* Am. J. Sci. **21,** 359 – 364 (1856)

Airy, G. B.: *Mémoire sur les expériences entreprises dans la mine de Harton pour déterminer la densité moyenne de la terre.* Arch. Sci. Phys. Nat. **35,** 15 – 29 (1857)

Airy, G. B.: *Supplement to the 'account of pendulum experiments undertaken in the Horton colliery' being an account of experiments undertaken to determine the correction for the temperature of the pendulum.* Proc. R. Soc. London **8,** 58 – 59 (1857)

Airy, G. B.: *On the pendulum experiments lately made in the Harton colliery, for ascertaining the mean density of the earth.* Proc. R. Instit. (G. B.) **2,** 17 – 22 (1858)

Airy, G. B.: *Account of pendulum experiments undertaken in the Harton colliery for the purpose of determining the mean density of the earth (with a supplement).* Mon. Not. R. Astron. Soc. **18,** 222 (1858)

Anikin, V. L., et al.*: *Torsion balance for measurements of the Cavendish constant of gravitation.* In: *Problems in Standardization, Metrology, and the Precise Measurement Technique,* Moscow, House of Standards, 1973

Anonymous: *Weighing the earth.* Spectrum, September 1967, 7

Augustin, R., de Boer, H., Haars, H., Michaelis, W.: *Ein haftreibungsfreies Quecksilber-Axiallager für die Präzisionsmessung sehr kleiner Drehmomente.* Feinwerktechnik und Meßtechnik **89,** 280 – 283 (1981)

Augustin, R., de Boer, H., Haars, H., Michaelis, W.: *Ein selbstzentrierendes Quecksilberlager.* Feinwerktechnik und Meßtechnik **90,** 411 – 413 (1982)

Avron, Y. and Livio, M.: *Considerations regarding a space-shuttle measurement of the gravitational constant.* Astrophys. J. **304,** L 61 – L 64 (1986)

Bacon, F.: *Opera Omnia,* Frankfurt a. M., Folio (1665)

Baille, J.-B.: *Sur la résistance le l'air dans les mouvements oscillatoires très lents.* C. R. Acad. Sci. **96,** 1493 – 1495 (1883)

Baille, J.-B.: *Influence de la température sur la valeur du couple de torsion des fils.* In: Association Française pour l'Avancement des Sciences: Comptes Rendus (Actes du Congrès), Paris 158 (1884)

Baily, F.: *Bericht von einigen Versuchen mit der Drehwage zur Bestimmung der mittleren Dichtigkeit der Erde.* Ann. Phys. (Leipzig) **57,** 453 – 467 (1842)

Baily, F.: *An account of some experiments with the torsion-rod for determining the mean density of the earth.* Philos. Mag. **21,** 111 – 121 (1842)

Baily, F.: *Résultats de quelques expériences faites avec la balance de torsion pour déterminer la densité moyenne de la terre.* Ann. Chim. Phys. **5,** 338 – 353 (1842)

Baily, F.: *Résultats de quelques expériences faites avec la balance de torsion pour déterminer la densité moyenne de la terre.* Bibliothèque Universelle de Genève **43,** 177 – 181 (1843)

Baily, F.: *Experiments with the torsion-rod for determining the mean density of the earth.* Mem. R. Astron. Soc. **14,** 1 – 120 and i – ccxlviii (1843)

Baily, F.: *An account of some experiments with the torsion-rod for determining the mean density of the earth.* Mon. Not. R. Astron. Soc. **5**, 188 (1843)

Baily, F.: *An account of some experiments with the torsion-rod for determining the mean density of the earth.* Mon. Not. R. Astron. Soc. **5**, 197–206 (1843)

Bartoli, A.: *Die Dichte eines festen Körpers, welcher alle einfachen Körper enthält, und Vergleichung derselben mit der mittleren Dichte der Erde.* Repertorium der Physik **22**, 123–126 (1886)

Barus, C.: *Gravitational attraction in connection with the rectangular interferometer.* Proc. Nat. Acad. Sci. USA **4**, 338–342 (1918)

Barus, C.: *The motion of a gravitating needle.* Science **50**, 214–216 (1919)

Barus, C.: *An example of torsional viscous retrogression.* Proc. Nat. Acad. Sci. USA **6**, 1–3 (1920)

Barus, C.: *Displacement interferometry applied to acoustics and to gravitation.* Publications of the Carnegie Institution of Washington. No. 310 (Part 1) 101–144 (1921)

Barus, C.: *Experiments with the vacuum gravitational needle.* Proc. Nat. Acad. Sci. USA **8**, 13–15 (1922)

Barus, C.: *Periods and logarithmic decrement of the gravitation needle under high exhaustion.* Proc. Nat. Acad. Sci. USA **8**, 63–66 (1922)

Barus, C.: *Static deflection, logarithmic decrement and first semiperiod of the vacuum gravitation needle.* Proc. Nat. Acad. Sci. USA **8**, 313–316 (1922)

Barus, C.: *The equilibrium positions of the vacuum gravitational needle in 1921 and 1922.* Proc. Nat. Acad. Sci. USA **8**, 327–330 (1922)

Barus, C.: *Static deflections of the vacuum gravitational needle, in 1921 and 1922.* Science **56**, 451–453 (1922)

Barus, C.: *Interferometer Experiments in acoustics and gravitation.* Publications of the Carnegie Institution of Washington, No. 310 (Part 2) 84–113 (1923)

Barus, C.: *Interferometer Experiments in acoustics and gravitation.* Publications of the Carnegie Institution of Washington, No. 310 (Part 3) 135–165 (1925)

Beams, J. W.: *Method of determining the gravitational constant G.* Proc. Virginia J. Sci. **15**, 269 (1964)

Beams, J. W. and Lowry, R. A.: *The determination of Newton's gravitational constant, G, with improved precision.* Final Report, NASA Institutional Subgrant, Code 4055-8320, 1964 (unpublished), 2 pp

Beams, J. W., Kulthau, A. R., Lowry, R. A., Parker, H. M.: *New method for measuring the gravitational constant G.* Bull. Am. Phys. Soc. **11**, 249 (1965)

Beams, J. W., Kulthau, A. R., Lowry, R. A., Parker, H. M.: *Determination of Newton's gravitational constant, G, with improved precision.* University of Virginia Status Report No. EP-4028-101-65U, June 1965 (unpublished), 25 pp

Beams, J. W., Kulthau, A. R., Lowry, R. A., Parker, H. M.: *Determination of Newton's gravitational constant, G, with improved precision.* University of Virginia Status Report No. EP-4028-102-65U, September 1965 (unpublished), 25 pp

Beams, J. W.: *Density gradient measurement in solids.* Bull. Am. Phys. Soc. **11**, 526 (1966)

Beams, J. W., Kulthau, A. R., Lowry, R. A., Parker, H. M.: *Determination of Newton's gravitational constant, G, with improved precision.* University of Virginia Status Report No. EP-4028-103-66U, May 1966 (unpublished), 24 pp

Beams, J. W., Kulthau, A. R., Lowry, R. A., Parker, H. M., Senter, J. P.: *Determination of Newton's gravitational constant, G, with improved precision.* University of Virginia Status Report No. EP-4028-104-66U, December 1966 (unpublished), 26 pp

Beams, J. W., Kulthau, A. R., Lowry, R. A., Parker, H. M., Senter, J. P.: *Determination of Newton's gravitational constant, G, with improved precision.* University of Virginia Status Report No. EP-4028-105-67U, June 1967 (unpublished), 26 pp

Beams, J. W., Kulthau, A. R., Lowry, R. A., Parker, H. M., Senter, J. P.: *Determination of Newton's gravitational constant, G, with improved precision.* University of Virginia Status Report No. EP-4028-106-67U, November 1967 (unpublished), 26 pp

Beams, J. W.: *Finding a better value for G.* Phys. Today **24**, 34–40 (1971)

Bell, Duane, Jacobsen, Kolm*: *Report on the 1949/50 Cavendish Experiment,* 8.11 Laboratory Report, Cambridge, Mass., MIT (1950)

Belokopytov, P. M., Boyevkin, V. I., Nikonov, B. S., Pavlov, Yu. N., Tolstousu, G. N.: *Torsional oscillation test stand for investigation of highly sensitive gravimetric and accelerometric instrumentation.* In: *Determination of Gravity Constant and Measurement Certain Fine Gravity Effects,* edited by Yu. D. Boulanger and M. U. Sagitov, NASA Technical Translation F-15722, Accession Code No. N74-30831, Washington, D.C., U.S. Government Printing Office 95–100 (1974)

Berget, A.: *Détermination expérimentale de la constante de l'attraction universelle, ainsi que de la masse et de la densité de la terre.* C.R. Acad. Sci. **116**, 1501–1503 (1893)

Berman, D.: *Discussion and analysis of the rotating flat plate Newtonian gravitational constant experiment.* In: *Research Toward Feasibility of an Instrument for Measuring Vertical Gradients of Gravity,* principal investigator Robert L. Forward, Final Report AFCRL-67-0631, Contract No. AF-19(628)-6134, Malibu, California, Hughes Research Laboratories F-1–F-35 (1967)

Berman, D.: *Discussion and analysis of the vertically tunneled sphere-Newtonian gravitational constant experiment.* In: *Research Toward Feasibility of an Instrument for Measuring Vertical Gradients of Gravity,* principal investigator Robert L. Forward, Final Report AFCRL-67-0631, Contract No. AF-19(628)-6134, Malibu, California, Hughes Research Laboratories, G-1–G-19 (1967)

Berman, D.: *Analysis of the rotating flat plate Newtonian gravitational constant experiment.* Hughes Research Laboratories Report No. 385, April 1968 (unpublished), 26 pp

Berman, D. and Forward, R. L.: *Free-fall experiments to determine the Newtonian gravitational constant (G).* In: *Exploitation of Space for Experimental Research,* Paper No. AAS68-053 in the Science and Technology Series, v. 24, Tarzana, California, American Astronautical Society 95–115 (1968)

Bessel, G. F.*: Abhandlungen der Königlich Preußischen Akademie der Wissenschaften zu Berlin 4 (1830)

Bessel, G. F.: *Collection de mémoires relatifs à la physique, publiés par la Société Française de Physique.* Mém. Rel. à la Phys. **5,** 72–133 (1889)

Beuke, D., de Boer, H., Haars, H., Michaelis, W.: *Fine displacement of cylindrical masses in the determination of the gravitation constant.* Feinwerktechnik und Meßtechnik **91,** 383–385 (1983)

Birch, T.: *The History of the Royal Society of London,* 4 v., London (1756)

Bleyer, U. and John, R. W.: *Zur theoretischen Analyse einer neuen Methode zur Bestimmung der Gravitationskonstante. I. Mechanische Größen des dynamischen Systems.* Gerlands Beitr. Geophys. (Leipzig) **85,** 402–414 (1976)

Bleyer, U., John, R. W., Liebscher, D.-E.: *On a new method of determining the gravitational constant.* In: *Abstracts of the Fourth Soviet Conference on Gravitation,* Minsk, USSR 146–148 (1976)

Bleyer, U. and John, R. W.: *Zur theoretischen Analyse einer neuen Methode zur Bestimmung der Gravitationskonstante. II. Bewegung der Probemasse.* Gerlands Beitr. Geophys. (Leipzig) **86,** 11–22 (1977)

Bleyer, U., John, R. W., Liebscher, D.-E.: *On a new method of determining the gravitational constant.* Gerlands Beitr. Geophys. (Leipzig) **86,** 148–152 (1977)

Bleyer, U., John, R. W., Liebscher, D.-E.*: *Erratum.* Gerlands Beitr. Geophys. (Leipzig) **86,** 344 (1977)

Bleyer, U., John, R. W., Liebscher, D.-E.*: *A new method of determining the gravitational constant using superconductive suspension.* Trans. Sternberg Astronomical Inst. **54,** 53–60 (1984)

Block, B., Moore, R. D., Roos, P.: *Do-it-yourself Cavendish balance.* Am. J. Phys. **33,** 963–965 (1965)

Bouguer, P.: *La Figure de la Terre,* Paris, 1749

Bouguer, P.*: *Sur la direction qu'affectent les fils-à-plomb.* Hist. de l'Acad. Roy. des Sci. avec les Mém. de Math. et de Phys. 1–10 (1754)

Bouguer, P.*: *Sur la direction qu'affectent les fils-à-plomb.* Hist. de l'Acad. Roy. des Sci. avec les Mém. de Math. et de Phys. 150–168 (1754)

Boulanger, Yu. D. and Sagitov, M. U.*: *Comments on the term 'Cavendish constant of gravitation'.* In: *Problems of Gravitational Measurements. Experimental Physics, Ser. B, v. 1,* Moscow, VNIIOFI (1971)

Boulanger, Yu. D. and Sagitov, M. U.: *Determination of gravity constant and measurement of certain fine gravity effects.* In: *Determination of the Gravity Constant and Measurement of Certain Fine Gravitational Effects,* edited by Yu. D. Boulanger and Sagitov, M. U., NASA Technical Translation F-15722, Accession Code No. N74-30831, Washington, D.C., U.S. Government Printing Office 1–7 (1974)

Boyle, R.*: *Works, v. 5,* edited by T. Birch, London, Folio (1744)

Boys, C. V.: *The radio-micrometer.* Philos. Trans. R. Soc. London, Ser. A **180,** 159–186 (1889)

Boys, C. V.: *On the Cavendish experiment.* Proc. R. Soc. London **46,** 253–268 (1889)

Boys, C. V.: *Royal Society Conversazione.* Nature (London) **40,** 65 (1889)

Boys, C. V.: *On the Cavendish experiment.* Nature (London) **41,** 155–159 (1889)

Boys, C. V.: *The Newtonian constant of gravitation.* Proc. R. Instit. (G. B.) **14,** 353–377 (1894)

Boys, C. V.: *On the Newtonian constant of gravitation.* Nature (London) **50,** 330–334 (1894)

Boys, C. V.: *On the Newtonian constant of gravitation.* Nature (London) **50,** 366–368 (1894)

Boys, C. V.: *On the Newtonian constant of gravitation.* Nature (London) **50,** 417–419 (1894)

Boys, C. V.: *The Newtonian constant of gravitation.* Nature (London) **50,** 571 (1894)

Boys, C. V.: *On the Newtonian constant of gravitation.* Proc. R. Soc. London **56,** 131–132 (1894)

Boys, C. V.: *The attachment of quartz fibers.* Philos. Mag. **37,** 463–467 (1894)

Boys, C. V.: *Über die Newton'sche Gravitationskonstante.* Beiblätter für Physik **19,** 229–230 (1895)

Boys, C. V.: *On the Newtonian constant of gravitation.* Philos. Trans. R. Soc. London, Ser. A **186,** 1–72 (1895)

Boys, C. V.: *The Newtonian constant of gravitation.* Arch. Sci. Phys. Nat. **33,** 179–180 (1895)

Boys, C. V.: *La constante de la gravitation.* In: *Rapports présentés au Congrès Internationale de Physique, v. 3,* Paris, Gauthiers-Villars 306–349 (1900)

Boys, C. V.: *Discussion.* Proc. Phys. Soc. London **29,** 163–170 (1917)

Boys, C. V.: *Discussion.* Chem. News **115,** 116–117 (1917)

Boys, C. V.: *Earth, the mean density of the.* In: *A Dictionary of Applied Physics,* edited by Sir Richard Glazebrook, London, Macmillan 279–285 (1923)

Boys, C. V.: *Quartz fibres.* In: *A Dictionary of Applied Physics,* edited by Sir Richard Glazebrook, London, Macmillan 695–699 (1923)

Boys, C. V.: *Radio-micrometer and some other instruments depending upon quartz fibres.* In: *A Dictionary of Applied Physics,* edited by Sir Richard Glazebrook, London, Macmillan 720–723 (1923)

Braun, C.: *Die Gravitations-Konstante, die Masse und mittlere Dichte der Erde nach einer neuen experimentellen Bestimmung.* Denkschriften der Academie der Wissenschaft zu Wien, Mathematische und Naturwissenschaftliche Klasse **64,** 187–258 (1897)

Braun, C.: *Die Gravitations-Konstante, die Masse und mittlere Dichte der Erde nach einer neuen experimentellen Bestimmung.* Naturwissenschaftliche Rundschau **12,** 273–277 (1897)

Braun, C.: *A new determination of the gravitation constant and the mean density of the earth (reported by J. H. Poynting).* Nature (London) **56,** 127–128 (1897)

Braun, C.: *The gravitation constant.* Nature (London) **56,** 198 (1897)

Braun, C.: *Die Gravitations-Konstante, die Masse und mittlere Dichte der Erde nach einer neuen experimentellen Bestimmung.* Beiblätter für Physik **21,** 561–563 (1897)

Braun, C.: *Über eine neue Bestimmung der mittleren Dichte der Erde durch Pater Braun (reported by F. K. Ginzel).* Himmel und Erde **10**(9), 385–395 (1898)

Braun, C.: *A new determination of the earth's density (reported by F. K. Ginzel).* Nature (London) **58,** 160 (1898)

Braun, C.: *Die Gravitations-Konstante, die Masse und mittlere Dichte der Erde nach einer neuen experimentellen Bestimmung (reported by F. Richarz).* Vierteljahrsschrift der Astronomischen Gesellschaft **33,** 33–44 (1898)

Bryzzhev, L. D.*: *Weighting technique for the determination of the constant of gravitation.* In: *Measurements of the Gravitational Acceleration and Constant,* Kharkov, KhGNIIM (1972)

Buchneva, L. G.*: *Nomograms allowing for torsion balance asymmetry in determination of the Cavendish constant.* In: *Problems of Gravitational Measurements, Experimental Physics, Ser. B, v. 1,* Moscow, VNIIOFI (1971)

Burgess, G. K.: *Méthode pour déterminer la constante newtonienne.* C. R. Acad. Sci. **129,** 407–409 (1899)

Burgess, G. K.: *Recherches sur la constante de gravitation.* Thèses présentées à la Faculté des Sciences de Paris pour obtenir le titre de Docteur de l'Université de Paris, Paris, Librairie Scientifique A. Hermann 62 pp (1901)

Burgess, G. K.: *A new form of Cavendish balance.* Phys. Rev. **14,** 247–256 (1902)

Burgess, G. K.: *The value of the gravitation constant.* Phys. Rev. **14,** 257–264 (1902)

Burgess, G. K.: *Constant of gravitation.* In: *Annual Report of the Director of the Bureau of Standards to the Secretary of Commerce for the Fiscal Year Ended June 30, 1927.* National Bureau of Standards (U.S.), Miscellaneous Publication 81, Washington, D.C., U.S. Government Printing Office 6 (1927)

Carlini, F.: *Osservazioni della lunghezza del pendolo semplice fatte all'altezza di mille tese sul livello del mare.* Eff. Astron. di Milano 28–40 (1824)

Carlini, F.*: *Osservazioni della lunghezza del pendolo semplice fatte all'altezza di mille tese sul livello del mare.* Bull. des Sc. Math. (Férussac) **3,** 298–301 (1825)

Cavendish, H.: *Experiments to determine the density of the earth.* Philos. Trans. R. Soc. London **88,** 469–526 (1798)

Cavendish, H.: *Experiments to determine the density of the earth (Expériences pour déterminer la densité de la terre).* Bibliothèque Britannique, Genève **11,** 233–241 (1799)

Cavendish, H.: *Versuche um die Dichtigkeit der Erde zu bestimmen.* Ann. Phys. (Leipzig) **2,** 1–62 (1799)

Cavendish, H.: *Expériences pour déterminer la densité de la terre.* Journal de l'Ecole Polytechnique **10,** 263–320 (1815)

Chapman, P. K.: *A Cavendish experiment in earth orbit.* M.I.T. preprint (unpublished) (1969)

Chen, Y. T. and Wang, Q.: *On the significance of the axial newtonian gravitational force of the finite cylinder.* Scientia Sinica (Series A) **26,** 732–738 (1983)

Chen, Y. T.: *Nonlinear effects in the determination of the gravitational constant by means of the swing time method.* Phys. Lett. A **106,** 19–22 (1984)

Chen, Y. T.: *Initial work of a new experiment to determine the gravitational constant by mechanical resonance method.* In: *Proceedings of the 7th International Conference on Atomic Masses and Fundamental Constants (AMCO-7),* edited by O. Klepper, New York, Plenum 705–711 (1984)

Clarke, A. R.: *Geodesy,* Oxford (1880)

Cook, A. H. and Parker, R. L.: *Some preliminary studies for a new determination of the constant of gravitation.* Report No. ST-3, National Physical Laboratory, Standards Division, Teddington, England, October 1962, 27 pp

Cook, A. H.: *A new determination of the constant of gravitation.* Contemp. Phys. **9,** 227–238 (1968)

Cook, A. H.: *The experimental determination of the constant of gravitation.* In: *Precision Measurement and Fundamental Constants I,* edited by D. N. Langenberg and B. N. Taylor, National Bureau of Standards (U.S.) Special Publication 343, Washington, D.C., U.S. Government Printing Office 475–483 (1971)

Cook, A. H. and Chen, Y. T.: *On the significance of the radial Newtonian gravitational force of the finite cylinder.* J. Phys. A: Math. Gen. **15,** 1591–1597 (1982)

Cornu, A. and Baille, J.-B.: *Détermination nouvelle de la constante de l'attraction et de la densité moyenne de la terre.* C. R. Acad. Sci. **76,** 954–958 (1873)

Cornu, A. and Baille, J.-B.: *Mutual determination of the constant of attraction, and of the mean density of the earth.* Chem. News **27,** 211 (1873)

Cornu, A. and Baille, J.-B.: *Etude de la résistance de l'air dans la balance de torsion.* C. R. Acad. Sci. **86,** 571–574 (1878)

Cornu, A. and Baille, J.-B.: *Sur la mesure de la densité moyenne de la terre.* C. R. Acad. Sci. **86,** 699–702 (1878)

Cornu, A. and Baille, J.-B.: *Influence des termes proportionnels au carré des écarts, dans le mouvement oscillatoire de la balance de la torsion.* C. R. Acad. Sci. **86,** 1001–1004 (1878)

Cornu, A. and Baille, J.-B.: *Bestimmung der mittleren Dichtigkeit der Erde.* Beiblätter zu den Annalen der Physik und Chemie **2,** 453–454 (1878)

Cornu, A.: *Researches on the mean density of the earth.* Mon. Not. R. Astron. Soc. **51,** 446–447 (1890)

Cornu, A.: *Researches on the mean density of the earth.* Nature (London) **44,** 327 (1891)

Cremieu, V.: *Détermination nouvelle de la constante newtonienne.* C. R. Acad. Sci. **149,** 700–702 (1909)

De Boer, H.: *Berichte der Abteilungen. 2.1.1 (Mechanik).* In: *Physikalisch-Technische Bundesanstalt, Jahresbericht 1976,* Braunschweig, PTB 38 (1977)

De Boer, H.: *Berichte der Abteilungen. 2.1.1 (Mechanik).* In: *Physikalisch-Technische Bundesanstalt, Jahresbericht 1978,* Braunschweig, PTB 40 (1979)

De Boer, H., Haars, H., Michaelis, W.: *Schwingungsisolierter Meßtisch mit Niveauregelung.* In:

Physikalisch-Technische Bundesanstalt, Jahresbericht 1979, Braunschweig, PTB 138 (1980)

De Boer, H., Haars, H., Michaelis, W.: *Ein schwingungsisolierter Meßtisch mit Niveauregelung.* Feinwerktechnik und Meßtechnik **88,** 233–236 (1980)

De Boer, H., Haars, H., Michaelis, W., Schlimme, E.: *Quadrantenelektrometer als Drehmomentmesser für kleine Drehmomente.* Feinwerktechnik und Meßtechnik **88,** 237–241 (1980)

De Boer, H., Haars, H., Michaelis, W.: *Selbstzentrierendes haftreibungsfreies Quecksilberlager.* In: *Physikalisch-Technische Bundesanstalt, Jahresbericht 1980 Kurzfassung*, Braunschweig, PTB 141 (1981)

De Boer, H., Haars, H., Michaelis, W.: *Verbesserung des Kapazitäts-Meßverfahrens bei der Bestimmung der Gravitationskonstante.* In: *Physikalisch-Technische Bundesanstalt, Jahresbericht 1985*, Braunschweig, PTB 176 (1986)

De la Condamine, Ch. M.: *Journal du Voyage,* Paris (1751)

De la Condamine, Ch. M.: *Supplément au Journal Historique, 2 parts, Paris (1752)*

Duane, B. H.: *Design of an apparatus to measure the gravitational constant.* B.S. Thesis, M.I.T., unpublished, 49 pp (1950)

Esposito, P. B.: *Evaluation of the geocentric gravitational constant from Viking doppler and range data.* J. Geophys. Res. **84,** 3654–3658 (1979)

Eötvös, R.: *Untersuchungen über Gravitation und Erdmagnetismus.* Ann. Phys. (Leipzig) **59,** 354–400 (1896)

Eötvös, R.: *Untersuchungen über Gravitation und Erdmagnetismus.* Math. és Term.-tud. Ert. **14,** 221–266 (1896)

Eötvös, R.: *Untersuchungen über Gravitation und Erdmagnetismus.* Math. und Naturwiss. Berichte aus Ungarn **13,** 193–243 (1896)

Eötvös, R.: *Untersuchungen über Gravitation und Erdmagnetismus.* In: *Gesammelte Arbeiten,* edited by P. Selényi, Budapest, Akademiai Kiado 25–68 (1953)

Eötvös, R.: *Determination of the gravity constant.* In: *The Constant of Gravitation,* edited by L. Stegna and M. U. Sagitov, Budapest, Eötvös University, Akadémiai Kiado 247–254 (1979)

Facy, L. and Pontikis, C.: *Détermination de la constante de gravitation par une méthode de résonance.* C.R. Acad. Sci. **270,** 15–18 (1970)

Facy, L. and Pontikis, C.: *Détermination de la constante de gravitation par la méthode de résonance.* C.R. Acad. Sci. **272,** 1397–1398 (1971)

Faller, J. E. and Koldewyn, W. A.: *A prototype measurement of the newtonian gravitation constant using an active magnetic suspension torsion fiber.* In: *Proceedings of the 1983 International School and Symposium on Precision Measurement and Gravity Experiment,* edited by W.-T. Ni, Hsinchu, Taiwan, National Tsing Hua University 541–556 (1983)

Faller, J. E., Keiser, G. M., Keyser, P. T.: *The fluid-fiber based torsion pendulum: an alternative to simply getting a bigger hammer.* In: *Proceedings of the 1983 International School and Symposium on Precision Measurement and Gravity Experiment,* edited by W.-T. Ni, Hsinchu, Taiwan, National Tsing Hua University 557–570 (1983)

Farinella, P., Milani, A., Nobili, A. M.*: *Measurement of the gravitational constant in space.* In: *Instabilities in Dynamic Systems,* edited by V. G. Szebehely, NATO Advanced Study Institute Series C, v. 47, Dordrecht, Reidel 296–297 (1979)

Farinella, P., Milani, A., Nobili, A. M.: *Measurement of the gravitational constant in space.* INIS ATOMINDEX **11,** 3275 (1980)

Farinella, P., Milani, A., Nobili, A. M.: *The measurement of the gravitational constant in an orbiting laboratory.* Astrophys. Space Sci. **73,** 417–433 (1980)

Faye, M.: *Sur les instruments géodésiques et sur la densité moyenne de la terre.* C.R. Acad. Sci. **56,** 557–566 (1863)

Faye, M.: *Sur les variations séculaires de la figure mathématique de la terre.* C.R. Acad. Sci. **90,** 1185–1191 (1880)

Faye, M.: *Sur la réduction des observations du pendule au niveau.* C.R. Acad. Sci. **90,** 1443–1446 (1880)

Ferrari, A. J., Sinclair, W. S., Sjogren, W. L., Williams, J. G., Yoder, C. F.: *Geophysical parameters of the earth-moon system.* J. Geophys. Res. **85,** 3939–3951 (1980)

Fialovszky, L.: *Nonlinear effects in the Eötvös method of the determination of the gravity constant.* In: *The Constant of Gravitation,* edited by L. Stegna and M. U. Sagitov, Budapest, Eötvös University, Akadémiai Kiado 221–245 (1979)

Fialovszky, L.: *On a new method of determining the gravitational constant.* Gerlands Beitr. Geophys. (Leipzig) **90,** 448 (1981)

Forward, R. L.: *Determination of the Newtonian gravitational constant.* In: *Research Toward Feasibility of an Instrument for Measuring Vertical Gradients of Gravity,* principal investigator Robert L. Forward, Final Report AFCRL-67-0631, Contract No. AF-19(628)-6134, Malibu, California, Hughes Research Laboratories 7–18 (1967)

Gerschun, A.: *Méthode pour déterminer la densité moyenne de la terre et la constante gravitationelle.* C.R. Acad. Sci. **129,** 1013–1015 (1899)

Gerschun, A.*: *An averaging method for the mean density of the earth and the constant of gravitation.* Proc. Russian Astron. Soc. **8,** (1900)

Gilbert, W.*: *De Magnete Magneticisque Corporibus et de Magno Magnete Tellure Physiologia Nova,* London (1600)

Gillies, G. T. and Marussi, A.: *Progress towards a new measurement of the mass of the earth.* Bolletino de Geofisica, Teorica ed Applicata, in the press

Gosselin, P. F. J.*: *Nouvel examen sur la densité moyenne de la terre.* Mém. Acad. Imp. de Metz **7,** 469–485 (1859)

Groten, E. and Thyssen-Bornemisza, S.: *Die Bestimmung der Gravitationskonstanten.* Z. für Vermessungswesen **97,** 105–106 (1972)

Gugel, L. G.: *Torsion balance-based determination of the constant of gravitation by the resonance technique.*

Comm. Sternberg Astronomical Inst. No. 187, 34–45 (1973)

Gugel, L. G.: *Comments on determination of the Cavendish constant of gravitation in stationary and pulsating gravitational fields.* Comm. Sternberg Astronomical Inst. No. 194, 21–28 (1976)

Gugel, L G.*: *A study of techniques for determination of the constant of gravitation.* Candidate Thesis, Moscow, Sternberg Institute, unpublished (1975)

Haughton, S.: *On the density of the earth, deduced from the experiments of the Astronomer Royal in the Harton coal-pit.* Philos. Mag. **12,** 50–51 (1856)

Haughton, S.: *Über die Dichtigkeit der Erde, hergeleitet aus den Versuchen des königlichen Astronomen (Hrn. Airy) in der Kohlengrube Harton.* Ann. Phys. (Leipzig) **99,** 332–334 (1856)

Haughton, S.*: *Über die Dichtigkeit der Erde, hergeleitet aus den Pendelbeobachtungen des Herrn Airy in der Kohlengrube Harton.* Z. Math. Phys. **2,** 68–70 (1857)

Haughton, S.*: *On the density of the earth, deduced from the experiments of the Astronomer Royal, in the Harton coal-pit.* Am. J. Sci. **24,** 158 (1857)

Heyl, P. R.: *A redetermination of the Newtonian constant of gravitation.* Phys. Rev. **29,** 910 (1927)

Heyl, P. R.: *A redetermination of the Newtonian constant of gravitation.* Proc. Nat. Acad. Sci. (U.S.) **13,** 601–605 (1927)

Heyl, P. R.: *A redetermination of the constant of gravitation.* J. Res. Natl. Bur. Stand. **5,** 1243–1290 (1930)

Heyl, P. R. and Chrzanowski, P.: *A new redetermination of the constant of gravitation.* J. Res. Natl. Bur. Stand. **29,** 1–31 (1942)

Hills, J. G.: *Space measurements of the gravitational constant using an artificial binary.* Astron. J. **92,** 986–988 (1986)

Hooke, R.*: *Posthumous Works,* London, Folio (1705)

Hulett, M. J.: *On the Newtonian gravitational constant.* B. A. Thesis, Wesleyan University, 97 pp (1969)

Hutton, C.: *An account of the calculations made from the survey and measures taken at Schehallien, in order to ascertain the mean density of the earth.* Philos. Trans. R. Soc. London **68,** 689–788 (1779)

Hutton, C.: *Calculations to determine at what point in the side of a hill its attraction will be the greatest, etc.* Philos. Trans. R. Soc. London **70,** 1–14 (1780)

Hutton, C.: *Calculations to determine at what point in the side of a hill its attraction will be the greatest, etc.* Philos. Trans. R. Soc. London **70,** 603–607 (1780)

Hutton, C.: *Letter from Dr. Hutton on the calculations for ascertaining the mean density of the earth.* Philos. Mag. **38,** 112–116 (1811)

Hutton, C.*: *Tracts on Mathematical and Philosophical Subjects, 3 v.,* London (1812)

Hutton, C.*: *Letters to Laplace.* J. Phys. (Blainville) **90,** 307–312 (1820)

Hutton, C.: *On the mean density of the earth.* Philos. Trans. R. Soc. London **111,** 276–292 (1821)

Hutton, C.: *On the mean density of the earth.* Philos. Mag. **58,** 3–13 (1821)

James, H.: *On the deflection of the plumb-line at Arthur's Seat and the mean specific gravity of the earth.* Philos. Trans. R. Soc. London **146,** 591–606 (1856)

James, H.: *On the figure, dimensions, and mean specific gravity of the earth, as derived from the ordnance trigonometrical survey of Great Britain and Ireland.* Philos. Trans. R. Soc. London **146,** 607–626 (1856)

James, H.: *Account of the observations and computations made for the purpose of ascertaining the amount of the deflection of the plumbline at Arthur's Seat, and the mean specific gravity of the earth.* Philos. Mag. **12,** 314–316 (1856)

James, H.: *On the deflection of the plumb-line at Arthur's Seat and on the mean density of the earth.* Proc. R. Soc. Edinburgh **3,** 364–366 (1857)

James, H.: *On the figure, dimensions, and mean specific gravity of the earth, as derived from the ordnance trigonometrical survey of Great Britain and Ireland.* Proc. R. Soc. London **8,** 111–116 (1857)

James, H.: *On the figure, dimensions, and mean specific gravity of the earth as derived from the ordnance trigonometrical survey of Great Britain and Ireland.* Philos. Mag. **13,** 129–132 (1857)

James, H.: *On the deflection of the plumb-line at Arthur's Seat, and the mean specific gravity of the earth.* Mon. Not. R. Astron. Soc. **18,** 220 (1858)

James, H.: *On the figure, dimensions, and mean specific gravity of the earth, as derived from the ordnance trigonometrical survey of Great Britain and Ireland.* Mon. Not. R. Astron. Soc. **18,** 220–222 (1858)

James, H. and Clarke, A. R.*: *Ordnance Trigonometrical Survey of Great Britain and Ireland. Account of the Observations and Calculations of the Principal Triangulation; and of the Figure, Dimensions, and Mean Specific Gravity of the Earth as Derived Therefrom, 2 v.,* London (1858)

James, H. and Clarke, A. R.: *Ordnance trigonometrical survey of Great Britain and Ireland. Account of the observations and calculations of the principal triangulations; and of the figure, dimensions, and mean specific gravity of the earth as derived therefrom.* Mon. Not. R. Astron. Soc. **19,** 194–199 (1859)

Joly, J.: *Notice of the December 13, 1889, meeting of the university experimental science association, Dublin, Ireland.* Nature (London) **41,** 256 (1890)

Kalinnikov, I. I.*: *A study of horizontal torsion balance for gravitational experiments.* Candidate Thesis, unpublished (1973)

Kalinnikov, I. I. and Kolosnitsyn, N. I.*: *Comments on the theory of the horizontal torsion balance with six degrees of freedom.* In: *Problems in Standardization, Metrology and the Precise Measurement Technique,* Moscow, Publication House of Standards (1973)

Kalinnikov, I. I. and Sagitov, M. U.: *Application of the transformation procedure to the determination of the Cavendish constant of gravitation.* Comm. Sternberg Astronomical Inst. No. 194, 14–20 (1976)

Kalinnikov, I. I. and Sagitov, M. U.: In: *Abstracts of the Fourth Soviet Conference on Gravitation, Minsk, USSR* 144–146 (1976)

Karagioz, O. V., Izmaylov, V. P., Kocheryan, E. G., Tarakanov, Yu. A.: *Experimental investigation of tor-*

sion systems of gravitational variometers in vacuum. Izv. Acad. Sci. USSR Phys. Solid Earth No. 2, 144–146 (1971) [translation of Izv. Akad. Nauk SSSR, Fiz. Zemli No. 2, 88–91 (1971)]

Karagioz, O. V., Tarakanov, Yu. A., Izmaylov, V. P.: *Energy scattering in vacuum torsion systems.* Izv. Acad. Sci. USSR Phys. Solid Earth No. 6, 413–416 (1971) [translation of Izv. Akad. Nauk SSSR, Fiz. Zemli No. 6, 69–78 (1971)]

Karagioz, O. V., Izmaylov, V. P., Tarakanov, Yu. A., Kocheryan, E. G.: *Effect of convection and nonequilibrium flows on the motion of a torsion balance.* Izv. Acad. Sci. USSR Phys. Solid Earth No. 11, 810–813 (1971) [translation of Izv. Akad. Nauk SSSR, Fiz. Zemli No. 11, 99–103 (1971)]

Karagioz, O. V., Kocheryan, E. G., Izmaylov, V. P.: *Increase of the Q-factor of the vacuum torsion systems by the annealing of the fibre.* Physics and Chemistry of Materials Processing No. 1, 87–90 (1972)

Karagioz, O. V., Voronkov, V. V., Izmaylov, V. P., Agafonov, N. I.: *Optimum parameters of a gravitational variometer.* Izv. Acad. Sci. USSR Phys. Solid Earth No. 1, 69–74 (1975) [translation of Izv. Akad. Nauk SSSR, Fiz. Zemli No. 1, 101–108 (1975)]

Karagioz, O. V., Izmaylov, V. P., Agafonov, N. I., Kocheryan, E. G., Tarakanov, Yu. A.: *The determination of the gravitational constant with an evacuated torsion balance.* Izv. Acad. Sci. USSR Phys. Solid Earth No. 5, 351–354 (1976) [translation of Izv. Akad. Nauk SSSR, Fiz. Zemli No. 5, 106–111 (1976)]

Karagioz, O. V., Kocheryan, E. G., Izmaylov, V. P., Bagmet, A. L.: *Damping the vibrations of torsional masses in a vacuum.* Vrashchenie & Prilivnye Deform. Zemli (USSR) No. 9, 108–111 (1977)

Karagioz, O. V., Shafranovskaya, M. M., Kononenko, I. V., Ponomorov, I. S., Izmaylov, V. P.: *Variometer oscillations at low amplitudes of swaying.* Appl. Geophys. No. 99, 117–124 (1981)

Karim, M., Toohey, W. J.: *Compensated Cavendish balance.* Am. J. Phys. **54,** 1043–1045 (1986)

Keller, F.: *Sulla diminuzione della gravità coll'altezza.* Atti Accad. Lincei **9,** 103–117 (1881)

Keller, F.: *Sul metodo di Jolly per la determinazione della densita media della terra.* Atti Accad. Lincei **2,** 145–149 (1886)

Keller, F.: *Sulla deviazione del filo a piombo prodotta dal prosciugamento del lago di Fucino.* Atti Accad. Lincei **3,** 493–501 (1887)

Kezhutin, N. G.*: *On errors in determination of the constant of gravitation caused by pendular oscillations of the torsion balance.* In: *Problems of Gravitational Measurements, Experimental Physics, Ser. B, v. 1,* Moscow, VNIIOFI (1971)

Kezhutin, N. G. and Milyukov, V. K.*: *Technical conditions of the experiment for determination of the constant of gravitation through the dynamic technique.* In: *Problems of Gravitational Measurements, Experimental Physics, Ser. B, v. 1,* Moscow, VNIIOFI (1971)

Kezhutin, N. G. et al.*: *Experience in production and precise measurement of cylindrical experimental masses for determination of the constant of gravitation.* In: *Problems in the Theory of Gravitation and Elementary Particles,* Moscow, Atomizdat 1975

Kezhutin, N. G.: *Pendular oscillations of the torsion balance.* Comm. Sternberg Astronomical Inst. No. 167, 34–42 (1970)

Koldewyn, W. A. and Faller, J. E.: *New method of measuring the gravitational constant, G.* Bull. Am. Phys. Soc. **17,** 472 (1972)

Koldewyn, W. A.: *A new method for measuring the Newtonian gravitational constant, G.* Ph. D. Dissertation, Wesleyan University 171 pp (1976)

Koldewyn, W. A.: *A new method for measuring the Newtonian gravitational constant.* Dissertation Abstracts International **37 B,** 1731–B (1976) [Abstract No. 76-23, 702]

Koldewyn, W. A.: *A new method for measuring the Newtonian gravitational constant, G.* Scientific and Technical Aerospace Reports **15,** 254 (1977)

König, A. and Richarz, F.: *Eine neue Methode zur Bestimmung der Gravitationsconstante.* Sitzungsberichte der Königlich Preußischen Akademie der Wissenschaften zu Berlin 1203–1205 (1884)

König, A. and Richarz, F.: *Eine neue Methode zur Bestimmung der Gravitationsconstante.* Ann. Phys. Chem. **24,** 664–668 (1885)

König, A.: *Notice of discussion at a physical society meeting of Dec. 19, 1884.* Nature (London) **31,** 260 (1885)

König, A. and Richarz, F.: *Proposed new method of measuring the density of the earth.* Science **5,** 217–218 (1885)

König, A. and Richarz, F.: *Communication to the Berlin Physical Society, Feb. 6, 1885.* Nature (London) **31,** 475–476 (1885)

König, A. and Richarz, F.: *Remarks on our method for determining the density of the earth.* Nature (London) **31,** 484 (1885)

Kunz, J.: *A resonance method for the determination of the universal constant of gravitation.* Phys. Rev. **29,** 910 (1927)

Kunz, J.: *Resonanzmethoden für die Bestimmung der Gravitationskonstante, G.* Phys. Z. **31,** 764–768 (1930)

Langevin, P.: *Résonance et forces de gravitation.* Ann. Phys. (Paris) **17,** 265–271 (1942)

Laska, W.: *über einen neuen Apparat zur Bestimmung der Erddichte.* Z. für Instrumentenkunde **9,** 354–355 (1889)

Lippmann, G.: *Sur l'entretien du mouvement pendulaire sans perturbation. Entretien du pendule géodésique.* C. R. Acad. Sci. **127,** 15–18 (1899)

Lippmann, G.: *Sur la mesure absolue de temps, déduite des lois de l'attraction universelle.* J. Phys. (Paris) **8,** 401–407 (1899)

Lowry, R. A. and Senter, J. P.: *The determination of Newton's gravitational constant, G, with improved precision.* University of Virginia Institutional Subgrant Application, January 1968, unpublished, 4 pp

Lowry, R. A, Towler, W. R., Parker, H. M., Kulthau, A. R, Beams, J. W.: *The gravitational constant G.* In: *Atomic Masses and Fundamental Constants, v. 4,* edited by J. H. Sanders and A. H. Wapstra, New York, Plenum 521–527 (1972)

Lowry, R. A. and Towler, W. R.: *Precision measurement of the Newtonian gravitational constant, G.* University of Virginia Progress Report ESS-4145-101-73U, January 1973, unpublished, 6 pp

Luther, G. G, Towler, W. R., Deslattes, R. D., Lowry, R. A., Beams, J. W.: *Initial results from a new measurement of the Newtonian gravitational constant.* In: *Atomic Masses and Fundamental Constants, v. 5,* edited by J. H. Sanders and A. H. Wapstra, New York, Plenum 592–598 (1976)

Luther, G. G. and Towler, W. R.: *Redetermination of the Newtonian gravitational constant, G.* Phys. Rev. Lett. **48,** 121–123 (1982)

Luther, G. G. and Towler, W. R.: *Redetermination of the Newtonian gravitational constant, G.* In: *Precision Measurement and Fundamental Constants II,* edited by B. N. Taylor and W. D. Phillips, National Bureau of Standards (U.S.) Special Publication 617, Washington, D.C., U.S. Government Printing Office 573–576 (1984)

Luther, G. G.: *Redetermination of the Newtonian gravitational constant "G".* In: *Proc. of the 3rd Marcel Grossmann Meeting on General Relativity,* edited by Hu Ning, Beijing, Science Press 827–838 (1983)

Luther, G. G., Deslattes, R. D., Towler, W. R.: *Single axis photoelectronic autocollimator.* Rev. Sci. Instrum. **55,** 747–750 (1984)

Mark, R., Mason, J., Neiman, M.: *Gravitational Constant Study.* RCA Laboratories Report No. AFCRL-63-842, 1963, unpublished, 105 pp

Martin, C. F. and Oh, I. H.: *Utilization of satellite-satellite tracking data for determination of the geocentric gravitational constant GM.* J. Geophys. Res. **84,** 3944–3950 (1979)

Marussi, A.: *Un nuovo esperimento per la determinazione della constante universale della gravitazione.* Memorie Soc. Astron. Ital. **43,** 823–824 (1972)

Maskelyne, N.: *A proposal for measuring the attraction of some hill in this kingdom by astronomical observations.* Philos. Trans. R. Soc. London **65,** 495–499 (1775)

Maskelyne, N.: *An account of observations made on the mountain Schehallien for finding its attraction.* Philos. Trans. R. Soc. London **65,** 500–542 (1775)

Maskelyne, N.: *How the earth was weighed (reported by S. Leadstone).* Scots Magazine **115,** 379–381 (1981)

Mayer, A. M.: *Methods of determining the density of the earth.* Nature (London) **31,** 408–409 (1885)

Meissner, H.: *Demonstration of gravitational attraction with the Cavendish balance.* Am. J. Phys. **25,** 639–640 (1957)

Menabrea, L. F.: *Calcul de la densité de la terre.* Mem. Accad. Torino **2,** 305–368 (1840)

Mendenhall, T. C.: *Determination of the acceleration due to the force of gravity, at Tokio, Japan.* Am. J. Sci. **20,** 124–132 (1880)

Mendenhall, T. C.: *On a determination of the force of gravity at the summit of Fujiyama, Japan.* Am. J. Sci. **21,** 98–103 (1881)

Mendenhall, T. C.: *Annual meeting of the U.S. National Academy of Sciences.* Nature (London) **56,** 19 (1897)

Metherell, A. J. F.: *The gravitational field of a hollow cylinder.* Cavendish Laboratory Preprint, unpublished (1981)

Metherell, A. J. F.: *The potential function of a right-circular hollow cylinder.* Cavendish Laboratory Preprint, (1981) unpublished

Metherell, A. J. F., Speake, C. C., Chen, Y. T., Faller, J. E.: *Optimizing the shape of the attracting mass in precision measurements of G.* In: *Precision Measurements and Fundamental Constants II,* edited by B. N. Taylor and W. D. Phillips, National Bureau of Standards (U.S.) Special Publication 617, Washington, D.C., U.S. Government Printing Office 581–586 (1984)

Metherell, A. J. F. and Quinn, T. J.: *The gravitational field of a 111 tetrahedron.* Metrologia **22,** 87–91 (1986)

Michaelis, W.: *Work carried out at the PTB to determine the gravitation constant.* Physikalisch-Technische Bundesanstalt Preprint, unpublished (1981)

Milyukov, V. K. and Sagitov, M. U.*: *Formulas for calculation of the derivatives of attraction potential of a circular finite-length cylinder.* In: *Problems of Gravitational Measurements, Experimental Physics, Ser. B, v. 1,* Moscow, VNIIOFI (1971)

Milyukov, V. K.: *Theoretical aspects of torsion balances to measure gravitational fields.* In: *Abstracts of the 5th Soviet Conference on Gravitation,* Moscow, Nauka 294 (1981)

Milyukov, V. K.*: *The theory of the motion of torsion balance in nonhomogeneous gravity field under the action of random noise.* In: *Problems in the Theory of Gravitation and Elementary Particles, Vol. 12,* Moscow, Energoizdat 128–140 (1981)

Milyukov, V. K.: *The research of the high-Q horizontal torsion balance in nonhomogeneous gravity field under the action of stochastic disturbances.* Trans. Sternberg Astronomical Inst. **53,** 170–178 (1983)

Monakhov, E. A.*: *On the two approaches to the decrease of the influence of the linear measurement errors on the accuracy of the gravitational constant determination.* Annales Universitatis Scientiarum Budapestinensis de Polando Eötvös nominatae. Separatum Sectio Geologica **23,** 131–138 (1981)

Monakhov, E. A.: *The Sternberg Institute experiment used for the new measurement of the Cavendish gravity constant.* Trans. Sternberg Astronomical Inst. **53,** 179–187 (1983)

Nash, J. H., Neeley, A. C., Steger, P. J.: *High-density tungsten spheres.* Union Carbide Corporation Nuclear Division, Oak Ridge Y-12 Plant Technical Report No. Y-1654, November 18, 1968, unpublished, 20 pp

National Academy of Sciences – National Research Council: *Space research – directions for the future.* NAS/NRC Publication 1403, Chapter IV, Washington, D.C. 329 (1966)

Nazarenko, V. S.: *A torsion oscillator recording system in the experiment of the Sternberg Institute for the new determination of the constant of gravitation.* Comm.

Sternberg Astronomical Inst. No. 202–203, 19–31 (1978)

Nazarenko, V. S.: *A torsion oscillator measurement system.* In: *Abstracts of the 5th Soviet Conference on Gravitation*, Moscow, Nauka 295 (1981)

Newton, I.: *Philosophiae Naturalis Principia Mathematica*, London (1687)

Newton, I.: *De Mundi Systemate*, London (1727)

Parker, H. M., Lowry, R. A., Kulthau, A. R., Beams, J. W.: *Precision method for measuring small torques, and its application to the universal gravitational constant.* Bull. Am. Phys. Soc. **11**, 850 (1966)

Parker, H. M.: *Discussion and analysis of the University of Virginia Newtonian gravitational constant experiment.* In: *Research Toward Feasibility of an Instrument for Measuring Vertical Gradients of Gravity*, principal investigator Robert L. Forward, Final Report AFCRL-67-0631, Contract No. AF-19(628)-6134. Malibu, California, Hughes Research Laboratories E-1–E-34 (1967)

Pechmann, E.*: *Die Abweichung der Lothlinie bei astronomischen Beobachtungsstationen und ihre Berechnung als Erfordernis einer Gradmessung.* Denkschrift. Akad. Wiss. Wien, Math.-Naturwiss. Kl. **22**, 41–88 (1864)

Playfair, J.: *Account of a lithological survey of Schehallian, made in order to determine the specific gravity of the rocks which compose that mountain.* Philos. Trans. R. Soc. London **101**, 347–377 (1811)

Pontikis, C.: *Détermination de la constante de gravitation par la méthode de résonance.* C.R. Acad. Sci. **274**, 437–440 (1972)

Pontikis, C.: *Sur une détermination de la constante de gravitation par résonance.* D. Sc. Thesis, Université de Paris VI, 86 pp (1972)

Pontikis, C.: *Sur une méthode de détermination de la constante de gravitation par résonance.* Dissertation Abstracts **41**, 867 (1978) [Abstract No. 5/5835c]

Popov, Ye. I.: *Fused quartz as a material for gravitational instruments.* In: *Determination of Gravity Constant and Measurement of Certain Fine Gravity Effects*, edited by Yu. D. Boulanger and M. U. Sagitov, NASA Technical Translation F-15,722, Accession Code No. N74-30831, Washington, D.C., U.S. Government Printing Office 83–94 (1974)

Poynting, J. H.: *On the estimation of small excesses of weight by the balance from the time of vibration and the angular deflection of the beam.* Manchester Literary and Philosophical Society Proceedings **18**, 33–38 (1879)

Poynting, J. H.: *On a method of using the balance with great delicacy, and on its employment to determine the mean density of the earth.* Proc. R. Soc. London **28**, 2–35 (1879)

Poynting, J. H.: *On a method of using the balance with great delicacy, and on its employment to determine the mean density of the earth (reported by F. Richarz).* Vierteljahrsschrift der Astronomischen Gesellschaft **24**, 18–32 (1889)

Poynting, J. H.: *On a determination of the mean density of the earth and the gravitational constant by means of the common balance.* Nature (London) **44**, 165–166 (1891)

Poynting, J. H.: *On a determination of the mean density of the earth and the gravitation constant by means of the common balance.* Philos. Trans. R. Soc. London, Ser. A **182**, 565–656 (1892)

Poynting, J. H.: *Über die Bestimmung der mittleren Dichte der Erde und der Gravitationskonstante mittels der gewöhnlichen Waage.* Physikalische Revue (Stuttgart) **1**, 456–468 (1892)

Poynting, J. H.: *Über die Bestimmung der mittleren Dichte der Erde und der Gravitationskonstante mittels der gewöhnlichen Waage.* Physikalische Revue (Stuttgart) **1**, 561–596 (1892)

Poynting, J. H.: *Über die Bestimmung der mittleren Dichte der Erde und der Gravitationskonstante mittels der gewöhnlichen Waage.* Physikalische Revue (Stuttgart) **1**, 700–719 (1892)

Poynting, J. H.: *Über die Bestimmung der mittleren Dichte der Erde und der Gravitationskonstante mittels der gewöhnlichen Waage.* Z. für Instrumentenkunde **12**, 422–427 (1892)

Poynting, J. H.: *Über die Bestimmung der mittleren Dichtigkeit der Erde und der Gravitationskonstante mittels der gewöhnlichen Waage (reported by O. Krigar-Menzel).* Naturwissenschaftliche Rundschau **8**, 625–629 (1893)

Poynting, J. H.: *The mean density of the earth.* Nature (London) **48**, 370 (1893)

Poynting, J. H. and Todd, G. W.: *On a method of determining the sensibility of a balance.* Philos. Mag. **18**, 132–135 (1909)

Poynting, J. H.: *Collected Scientific Papers*, Cambridge, Cambridge University Press 1920

Pratt, J. H.: *On the attraction of the Himalaya mountains, and of the elevated regions beyond them, upon the plumb-line in India.* Philos. Trans. R. Soc. London **145**, 53–100 (1855)

Pratt, J. H.: *On the effect of local attraction upon the plumb-line at stations on the English arc of the meridian, between Dunnose and Burleighmoor; and a method of computing its amount.* Philos. Trans. R. Soc. London **146**, 31–52 (1856)

Pratt, J. H.: *On the attraction of the Himalaya mountains and of the elevated regions beyond them, upon the plumb-line in India.* Mon. Not. R. Astron. Soc. **16**, 36–41 (1856)

Pratt, J. H.: *Report on the Himalayan plumb-line experiments.* Mon. Not. R. Astron. Soc. **16**, 104–105 (1856)

Pratt, J. H.*: *A Treatise on Attractions, La Place's Functions, and the Figure of the Earth, 3rd ed.*, Cambridge, 1865

Preston, E. D.: *Geodesy. Determinations of latitude, gravity, and the magnetic elements at stations in the Hawaiian islands, including a result for the mean density of the earth.* In: *Report of the U.S. Coast and Geodetic Survey, Appendix No. 12*, Washington, D.C., U.S. Government Printing Office 509–639 (1893)

Preston, E. D.: *Mean density of the earth.* Philos. Soc. Washington **12**, 369–395 (1895)

Preston, E. D.: *De mittlere Dichte der Erde.* Beiblätter für Physik **21,** 488–489 (1897)

Preston, E. D.: *Mean density of the earth (Densité moyenne de la terre – reviewed by E. Bouty).* J. Phys. (Paris) **6,** 542–544 (1897)

Reich, F.: *Extrait d'un mémoire de M. Reich sur la densité de la terre (Communiqué par M. Elie de Beaumont).* C. R. Acad. Sci. **5,** 697–700 (1837)

Reich, F.: *Versuche über die mittlere Dichtigkeit der Erde mittels der Drehwaage,* Freiberg, J. G. Engelhardt Verlag 1838, 66 pp

Reich, F.: *On the repetition of the Cavendish experiment for determining the mean density of the earth (reported by F. Baily).* Philos. Mag. **12,** 283–284 (1838)

Reich, F.: *On the repetition of the Cavendish experiment, for determining the mean density of the earth (reported by F. Baily).* Mon. Not. R. Astron. Soc. **4,** 96–97 (1839)

Reich, F.: *Neue Versuche mit der Drehwaage.* Abhandlungen der Königliche S. Ges. der Wissenschaften (Leipzig), Mathematische-Naturwissenschaftliche Klasse **1,** 385–430 (1852)

Reich, F.: *Neue Versuche über die mittlere Dichtigkeit der Erde.* Ann. Phys. (Leipzig) **161,** 189–198 (1852)

Reich, F.: *Nouvelles expériences sur la densité moyenne de la terre.* Ann. Chim. Phys. (Paris) **38,** 382–383 (1853)

Reich, F.: *New experiments on the mean density of the earth.* Philos. Mag. **5,** 153–158 (1853)

Renner, Y.: *On experimental studies for new determination of the constant of gravitation.* Comm. Sternberg Astronomical Inst. No. 167, 3–8 (1970)

Renner, Y.: *Determination of gravitational constant in Budapest.* In: *Determination of Gravity Constant and Measurement of Certain Fine Gravity Effects,* edited by Yu. D. Boulanger and M. U. Sagitov, NASA Technical Translation F-15,722, Accession Code No. N 74-30831, Washington, D.C., U.S. Government Printing Office 26–31 (1974)

Richarz, F. and Krigar-Menzel, O.: *Die Abnahme der Schwere mit der Höhe, bestimmt durch Wägungen.* Sitzungsberichte der Königlich Preußischen Akademie der Wissenschaften zu Berlin No. 16, 163–183 (1893)

Richarz, F. and Krigar-Menzel, O.: *Die Abnahme der Schwere mit der Höhe, bestimmt durch Wägungen.* Mathematische und Naturwissenschaftliche Mittheilungen aus den Sitzungsberichten der Königlich Preußischen Akademie der Wissenschaften zu Berlin 81–101 (1893)

Richarz, F. and Krigar-Menzel, O.: *Die Abnahme der Schwere mit der Höhe, bestimmt durch Wägungen.* Ann. Phys. (Leipzig) **51,** 559–583 (1894)

Richarz, F. and Krigar-Menzel, O.: *Gravitationskonstante und mittlere Dichtigkeit der Erde, bestimmt durch Wägungen.* Sitzungsberichte der Königlich Preußischen Akademie der Wissenschaften zu Berlin **48,** 1305–1318 (1896)

Richarz, F. and Krigar-Menzel, O.: *Gravitationskonstante und mittlere Dichtigkeit der Erde, bestimmt durch Wägungen.* Mathematische und Naturwissenschaftliche Mittheilungen aus den Sitzungsberichten der Königlich Preußischen Akademie der Wissenschaften zu Berlin 681–696 (1896)

Richarz, F. and Krigar-Menzel, O.: *The gravitation constant and the mean density of the earth.* Nature (London) **55,** 296 (1897)

Richarz, F. and Krigar-Menzel, O.: *Gravitationskonstante und mittlere Dichtigkeit der Erde, bestimmt durch Wägungen.* Z. für Instrumentenkunde **17,** 119–121 (1897)

Richarz, F. and Krigar-Menzel, O.: *Gravitationskonstante und mittlere Dichtigkeit der Erde, bestimmt durch Wägungen.* Ann. Phys. (Leipzig) **66,** 177–193 (1898)

Richarz, F. and Krigar-Menzel, O.*: *Bestimmung der Gravitationsconstante und mittleren Dichtigkeit der Erde durch Wägungen.* Anhang zu den Abhandlungen der Königlich Preußischen Akademie der Wissenschaften zu Berlin 1–196 (1898)

Richarz, F. and Krigar-Menzel, O.: *Bestimmung der Gravitationsconstante und der mittleren Dichtigkeit der Erde durch Wägungen (reported by C. Braun).* Vierteljahrsschrift der Astronomischen Gesellschaft **34,** 51–66 (1899)

Richarz, F. and Krigar-Menzel, O.: *Waage zur Bestimmung der mittleren Dichtigkeit der Erde.* Z. für Instrumentenkunde **19,** 40–56 (1899)

Richarz, F. and Krigar-Menzel, O.: *Remarques sur le rapport de M. C. V. Boys.* In: *Travaux du Congrès International de Physique,* Paris, Gauthier-Villars 69–73 (1901)

Ritter, R. C. and Gillies, G. T.: *A satellite measurement of G to a part per million.* University of Virginia Preprint, unpublished, 5 pp (1981)

Ritter, R. C. and Gillies, G. T.: *A satellite measurement of G to a part per million.* Bull. Am. Phys. Soc. **29,** 703 (1984)

Rose, R. D.: *A new method for determination of Newton's gravitational constant.* Ph. D. Thesis, University of Virginia, 90 pp (1969)

Rose, R. D., Parker, H. M., Lowry, R. A., Kulthau, A. R., Beams, J. W.: *Determination of the gravitational constant G.* Phys. Rev. Lett. **23,** 655–658 (1969)

Sagitov, M. U.: *Contribution to the theory of determination of the constant of gravitation by means of torsional oscillations of a beam with masses.* Comm. Sternberg Astronomical Inst. No. 135, 3–18 (1964)

Sagitov, M. U.*: *Contribution to the theory of a technique for determination of the constant of gravitation.* In: *Abstracts of the 2nd Soviet Conference on Gravitation,* Tbilissi 265 (1965)

Sagitov, M. U.: *Effects of the gravitational field due to surrounding masses on the determination of the gravitational constant by the method of torsional oscillations.* Moscow Univ. Phys. Bull. **24**(3), 69–73 (1972) [translation of Vest. Mosk. Univ., Fiz. **24**(3), 87–91 (1969)]

Sagitov, M. U.*: *Determination of the constant of gravitation and the mass of the earth: an overview.* In: *Determination of the Constant of Gravitation, the Mass and the Mean Density of the Earth,* Moscow, Abstracts of the Conference, October 13–16 (1970)

Sagitov, M. U.*: *Brief review of experiments for determination of the constant of gravitation.* In: *Measurements of the Gravitational Acceleration and the Constant of Gravitation,* Kharkov, KhGNIIM (1970)

Sagitov, M. U.: *The moment of mutual attraction forces between the experimental masses in the problem of determination of the constant of gravitation.* Comm. Sternberg Astronomical Inst. No. 167, 9 – 23 (1970)

Sagitov, M. U.: *Comments on the theory of determination of the constant of gravitation by means of the torsion balance technique.* Comm. Sternberg Astronomical Inst. No. 167, 24 – 33 (1970)

Sagitov, M. U.: *Bulletin d'Information No. 27,* Paris, Bureau Gravimetrique International, 1-21 – 1-22 (1971)

Sagitov, M. U.*: *Necessity for a new determination of the Cavendish constant of gravitation.* In: *Problems of Gravitational Measurements, Experimental Physics, Ser. N, v. 1,* Moscow, VNIIOFI (1971)

Sagitov, M. U. and Chesnokova, T. S.*: *The mutual attraction force moment of experimental masses in the form of circular cylinders.* In: *Problems of Gravitational Measurements, Experimental Physics, Ser. B, v. 1,* Moscow, VNIIOFI (1971)

Sagitov, M. U. and Buchneva, L. G.*: *Determination of the constant of gravitation in the case of non-symmetrical and non-symmetrically disposed experimental masses.* In: *Measurements of the Gravitational Acceleration and the Constant of Gravitation,* Kharkov, KhGNIIM (1972)

Sagitov, M. U.: *On the moment of mutual attraction forces between experimental masses.* Comm. Sternberg Astronomical Inst. No. 187, 3 – 12 (1973)

Sagitov, M. U.: *A procedure for derivation of unknown parameters in the problem of determination of the constant of gravitation.* Comm. Sternberg Astronomical Inst. No. 187, 13 – 19 (1973)

Sagitov, M. U. and Chesnokova, T. S.: *Experiment in determination of a general law for attenuation of vibrations.* In: *Determination of Gravity Constant and Measurement of Certain Fine Gravity Effects,* edited by Yu. D. Boulanger and M. U. Sagitov, NASA Technical Translation F-15,722, Accession Code No. N 74-30831, Washington, D.C., U.S. Government Printing Office 69 – 74 (1974)

Sagitov, M. U. and Kezhutin, N. G.: *A correction in determination of the Cavendish constant.* In: *Determination of Gravity Constant and Measurement of Certain Fine Gravity Effects,* edited by Yu. D. Boulanger and M. U. Sagitov, NASA Technical Translation F-15,722, Accession Code No. N 74-30831, Washington, D.C., U.S. Government Printing Office 32 – 37 (1974)

Sagitov, M. U., Nazarenko, V. S., Monakhov, E. A., Milyukov, V. K., Chesnokova, T. S., Dmitrieva, T. I., Tadzhidinov, Kh. G.: *A new apparatus for measurement of the Cavendish gravitational constant.* In: *Abstracts of the 4th Soviet Conference on Gravitation, Minsk,* Akad. Nauk SSSR 143 – 144 (1976)

Sagitov, M. U., Milyukov, V. K., Monakhov, E. A., Nazarenko, V. S., Chesnokova, T. S., Dmitrieva, T. I., Golizinskii, L. W.: *On the determination of the Cavendish constant of gravitation.* Comm. Sternberg Astronomical Inst. No. 202-203, 3 – 18 (1978)

Sagitov, M. U., Milyukov, V. K., Monakhov, E. A., Nazarenko, V. S., Tadzhidinov, Kh. G.: *A new determination of the Cavendish gravitational constant.* Dokl. Akad. Nauk SSSR, Earth Sciences 245, 20 – 22 (1981) [translation of Dokl. Akad. Nauk SSSR 245, 567 – 569 (1979)]

Sagitov, M. U., Milyukov, V. K., Monakhov, E. A., Nazarenko, V. S., Tadzhidinov, Kh. G.: *New determination of the Cavendish gravitational constant.* Int. Aerospace Abstracts No. A 79-37197, 2866 (1979)

Sagitov, M. U., Milyukov, V. K., Monakhov, E. A., Nazarenko, V. S., Chesnokova, T. S., Tadzhidinov, Kh. G., Dmitrieva, T. I.: *Determination of the Cavendish gravitational constant at the Sternberg State Astronomical Institute of the Moscow University.* In: *The Constant of Gravitation,* edited by Lajos Stegna and Marat U. Sagitov, Budapest, Lorand Eötvös University, Akadémiai Kiado 25 – 203 (1979)

Sagitov, M. U., Milyukov, V. K., Monakhov, E. A., Nazarenko, V. S., Tadzhidinov, Kh. G.: *A new determination of the Cavendish gravitational constant.* In: *Abstracts of the 5th Soviet Conference on Gravitation,* Moscow, Nauka 296 (1981)

Sagitov, M. U. and Milyukov, V. K.: *The constant of gravitation.* Earth and Universe No. 3, 37 – 42 (1981)

Sagitov, M. U.: *Nonhomogeneity of the gravitational field in buildings and the choice of places for experiments on the gravity field.* Izv. Akad. Nauk SSSR, Fiz. Zemli No. 3, 41 – 49 (1984)

Sagitov, M. U.: *The effects of laboratory-scaled gravity-field inhomogeneity in gravity measurements.* Izv. Akad. Nauk SSSR, Fiz. Zemli No. 4, 46 – 59 (1984)

Schaar, M.: *Rapport de M. Schaar sur un mémoire de M. Montigny relatif aux expériences pour déterminer la densité de la terre.* Bull. Acad. Roy. Belgique **19** (part 2), 476 – 481 (1852)

Smalley, L. L.: *Gravitational clock: A proposed experiment for the measurement of the gravitational constant G.* NASA Technical Memorandum X-64,920, Accession Code No. N 75-22974, Washington, D.C., U.S. Government Printing Office 31 pp (1975)

Smalley, L. L.: *Gravitational clock: A proposed experiment for the measurement of the gravitational constant G.* Scientific and Technical Aerospace Reports **13,** 1687 (1975)

Southwell, W. H.: *Using pendulums to measure the universal gravitational constant.* Am. J. Phys. **35,** 1160 – 1161 (1967)

Speake, C. C. and Metherell, A. J. F.: *The design of a beam balance for a determination of G.* In: *Precision Measurement and Fundamental Constants II,* edited by B. N. Taylor and W. D. Phillips, National Bureau of Standards (U.S.) Special Publication 617, Washington, D.C., U.S. Government Printing Office 577 – 580 (1984)

Speake, C. C.: *A beam balance method for determination of the Newtonian constant of gravitation.* Ph. D. Thesis, Cambridge University, 148 pp (1983)

Speake, C. C. and Gillies, G. T.: *The beam balance as a detector in experimental gravitation.* Proc. Roy. Soc. London A, in press

Speake, C. C.: *Note on the optimum positioning of attracting masses in the Heyl type of determination of the Newtonian gravitational constant.* Metrologia, in press

Stacey, F. D.: *Possibility of a geophysical determination of the Newtonian gravitational constant.* Geophys. Res. Lett. **5,** 377 – 378 (1978)

Stegna, L.*: In: *Proceedings of the Second Symposium of the Working Group 6.6 ("Constant of Gravitation and Mass of the Earth") of the KAPS,* Moscow, Commission of the Academies of Socialist Countries for Planetary Geophysics, December 3 – 4 (1974)

Stegna, L. and Sagitov, M. U.: *The constant of gravitation in various systems of units and a brief overview of the determinations of the Cavendish constant of gravitation.* In: *The Constant of Gravitation,* edited by L. Stegna and M. U. Sagitov, Budapest, Lorand Eötvös University, Akadémiai Kiado 5 – 24 (1979)

Stegna, L.: *The Eötvös experiment for the determination of the gravity constant.* In: *The Constant of Gravitation,* edited by L. Stegna and M. U. Sagitov, Budapest, Lorand Eötvös University, Akadémiai Kiado 205 – 220 (1979)

Stern, T. E.: *A determination of the Newtonian constant of gravitation by a study of the vibrations of a torsion pendulum.* Science **67,** 377 – 378 (1928)

Struve, O.*: *Über einen von General Schubert an die Akademie gerichteten Antrag betreffend die Russisch-Scandinavische Meridiangradmessung.* Bull. Acad. St. Petersburg, Physikalisch-Mathematische Klasse **3,** 395 – 424 (1861)

Tadzhidinov, Kh. G.: *Special cases of decomposition of the moment of mutual attraction forces between the experimental masses.* Comm. Sternberg Astronomical Inst. No. 187, 46 – 49 (1973)

Tangl, K.: *Versuch über die Gravitation mit einer Drehwaage, deren Gehänge in Wasser taucht.* Mathematischer und Naturwissenschaftlicher Anzeiger der Akademie der Wissenschaften zu Budapest **43,** 342 – 352 (1926)

Tarakanov, Y. A. and Ivankin, L. G.: *Measuring the vertical gravity gradient by the motion of a torsion balance.* Izv. Acad. Sci. USSR Phys. Solid Earth No. 11, 691 – 693 (1968) [translation of Izv. Akad. Nauk SSSR, Fiz. Zemli No. 11, 63 – 66 (1968)]

Tarakanov, Y. A. and Ivankin, L. G.: *A disturbance-resistant group of torsion balances.* Izv. Acad. Sci. USSR Phys. Solid Earth No. 11, 694 – 695 (1968) [translation of Izv. Akad. Nauk SSSR, Fiz. Zemli No. 11, 67 – 70 (1968)]

Tarakanov, Y. A.: *Disturbance-resistance with respect to inertial perturbations of the second derivatives of the Newtonian potential.* Izv. Acad. Sci. USSR Phys. Solid Earth No. 1, 35 – 41 (1970) [translation of Izv. Akad. Nauk SSSR, Fiz. Zemli No. 1, 52 – 63 (1970)

Tarakanov, Yu. A. and Karatsuba, V. B.: *Effects of microseisms on torsion balances.* In: *Determination of Gravity Constant and Measurement of Certain Fine Gravity Effects,* edited by Yu. D. Boulanger and M. U. Sagitov, NASA Technical Translation F-15,722, Accession Code No. N 74-30831, Washington, D.C., U.S. Government Printing Office 48 – 59 (1974)

Towler, W. R.: *A control system for driving a precision rotary table.* M.S. Thesis, University of Virginia, 66 pp (1967)

Towler, W. R. and McVey, E. S.: *Control system for use in the measurement of ultrasmall torques.* IEEE Trans. Auto. Control, AC-14, 190 – 192 (1969)

Towler, W. R., Parker, H. M., Lowry, R. A., Kulthau, A. R., Beams, J. W.: *Measurement of the Newton gravitational constant G.* In: *Precision Measurement and Fundamental Constants I,* edited by D. N. Langenberg and B. N. Taylor, National Bureau of Standards (U.S.) Special Publication 343, Washington, D.C., U.S. Government Printing Office 485 – 492 (1971)

Towler, W. R.: *Analysis and evaluation of errors in the measurement of the Newtonian gravitational constant G.* University of Virginia Progress Report No. ESS-3896-101-76, April 1976, unpublished, 28 pp

Turmlirz, O.: *Die Dichte der Erde, berechnet aus der Schwerebeschleunigung und der Abplattung.* Denkschrift. Akad. Wiss. Wien, Math.-Naturwiss. Kl. **59,** 1528 – 1536 (1892)

Vinti, J. P.: *Analysis of an experiment to determine the gravitational constant in an orbiting space laboratory.* M.I.T. Measurement Systems Laboratory Report No. RE-72. In: NASA Contractor Report No. CR-115139, Cambridge, Mass., M.I.T. 55 pp (1970)

Vinti, J. P.: *Analysis of the gravitational field in Wilk's sphere with three tunnels.* M.I.T. Measurement Systems Laboratory Report No. RE-73. In: NASA Contractor Report No. CR-115139, Cambridge, Mass., M.I.T. 31 pp (1970)

Vinti, J. P.: *Theory of an experiment in an orbiting space laboratory to determine the gravitational constant.* Celest. Mech. **5,** 204 – 254 (1972)

Von Jolly, Ph.: *Die Anwendung der Waage auf Probleme der Gravitation.* Ann. Phys. (Leipzig) **5,** 112 – 134 (1878)

Von Jolly, Ph.: *Die Anwendung der Waage auf Probleme der Gravitation.* Abhandlungen der Bayerischen Akademie der Wissenschaften, Klasse 2 **13** (Abteilung 1), 157 – 176 (1878)

Von Jolly, Ph.: *Die Anwendung der Waage auf Probleme der Gravitation.* Zweite Abhandlung. Ann. Phys. (Leipzig) **14,** 331 – 355 (1881)

Von Jolly, Ph.: *Die Anwendung der Waage auf Probleme der Gravitation.* Zweite Abhandlung. Abhandlungen der Bayerischen Akademie der Wissenschaften, Klasse 2 **14** (Abteilung 2), 3 – 26 (1881)

Von Jolly, Ph.: *A new weighing of the earth.* Popular Science Monthly **21,** 565 (1882)

Von Jolly, Ph.: *Die Anwendung der Waage auf Probleme der Gravitation (reported by F. Richarz).* Vierteljahrsschrift der Astronomischen Gesellschaft **24,** 18 – 32 (1889)

Von Sterneck, R.: *Untersuchungen über die Schwere im Innern der Erde.* Mittheilungen des Kaiserlich Königlich Militär-Geographischen Institutes (Wien) **2,** 77 – 120 (1882)

Von Sterneck, R.: *Wiederholung der Untersuchungen über die Schwere im Innern der Erde.* Mittheilungen des Kaiserlich Königlich Militär-Geographischen Institutes (Wien) **3,** 59–94 (1883)

Von Sterneck, R.: *Untersuchungen über die Schwere auf der Erde.* Mittheilungen des Kaiserlich Königlich Militär-Geographischen Institutes (Wien) **4,** 89–155 (1884)

Von Sterneck, R.: *Fortsetzung der Untersuchungen über die Schwere auf der Erde.* Mittheilungen des Kaiserlich Königlich Militär-Geographischen Institutes (Wien) **5,** 77–105 (1885)

Von Sterneck, R.: *Untersuchungen über die Schwere im Innern der Erde.* Mittheilungen des Kaiserlich Königlich Militär-Geographischen Institutes (Wien) **6,** 97–119 (1886)

Whewell, M. and Airy, G. B.: *On experiments at Dolcoath mine in Cornwall to determine the density of the earth.* Philos. Mag. **1,** 385–386 (1827)

Wilsing, J.: *Über die Anwendung des Pendels zur Bestimmung der mittleren Dichtigkeit der Erde.* Sitzungsberichte der Königlich Preußischen Akademie der Wissenschaften zu Berlin, Erster Halbband 13–15 (1885)

Wilsing, J.: *Über die Anwendung des Pendels zur Bestimmung der mittleren Dichtigkeit der Erde.* Beiblätter für Physik **9,** 768 (1885)

Wilsing, J.: *Teil G. Vermischte astronomische oder physikalische Beobachtungen (reported by H. C. Vogel).* Vierteljahrsschrift der Astronomischen Gesellschaft **20,** 126 (1885)

Wilsing, J.: *Instrumente.* Vierteljahrsschrift der Astronomischen Gesellschaft **21,** 132 (1886)

Wilsing, J.: *Teil G. Vermischte astronomische und physikalische Beobachtungen (reported by H. C. Vogel).* Vierteljahrsschrift der Astronomischen Gesellschaft **21,** 141–142 (1886)

Wilsing, J.: *Teil G. Vermischte astronomische und physikalische Beobachtungen.* Vierteljahrsschrift der Astronomischen Gesellschaft **22,** 149–151 (1887)

Wilsing, J.: *Bestimmung der mittleren Dichtigkeit der Erde mit Hülfe eines Pendelapparates.* Publicationen des Astrophysikalischen Observatoriums zu Potsdam **6**(22), 35–127 (1887)

Wilsing, J.: *Mittheilung über die Resultate von Pendelbeobachtungen zur Bestimmung der mittleren Dichtigkeit der Erde.* Sitzungsberichte der Königlich Preußischen Akademie der Wissenschaften zu Berlin, Erster Halfband 327–334 (1887)

Wilsing, J.: *Mittheilung über die Resultate von Pendelbeobachtungen zur Bestimmung der Dichtigkeit der Erde.* Mathematische und Naturwissenschaftliche Mittheilungen aus den Sitzungsberichten der Königlich Preußischen Akademie der Wissenschaften zu Berlin 157–164 (1887)

Wilsing, J.: *Teil G. Vermischte astronomische und physikalische Beobachtungen.* Vierteljahrsschrift der Astronomischen Gesellschaft **23,** 128–130 (1888)

Wilsing, J.: *Determination of the mean density of the earth by means of a pendulum principle (translated by J. H. Gore).* In: *Annual Report of the Board of Regents of the Smithsonian Institution* 635–646 (1888)

Wilsing, J.: *Bestimmung der mittleren Dichtigkeit der Erde mit Hülfe eines Pendelapparates (reported by F. Richarz).* Vierteljahrsschrift der Astronomischen Gesellschaft **24,** 18–32 (1889)

Wilsing, J.: *Bestimmung der mittleren Dichtigkeit der Erde mit Hülfe eines Pendelapparates (Zweite Abhandlung).* Publicationen des Astrophysikalischen Observatoriums zu Potsdam **6,** (23), 133–193 (1889)

Wilsing, J.: *Bestimmung der mittleren Dichtigkeit der Erde mit Hülfe eines Pendelapparates (Zweite Abhandlung).* Vierteljahrsschrift der Astronomischen Gesellschaft **24,** 184–186 (1889)

Woodward, R. S.: *The gravitational constant and the mean density of the earth.* Astron. J. **18,** 121–122 (1898)

Woodward, R. S.: *The gravitation constant and the mean density of the earth.* Proc. Am. Assoc. Adv. Sci. **47,** 73–74 (1898)

Zahradnicek, J.: *Mesure de la période du gravimètre.* Publications de la Faculté des Sciences de l'Université Masaryk No. 118, 1–14 (1930)

Zahradnicek, J.: *Mesure de la constante de gravitation par la balance de torsion.* Publications de la Faculté des Sciences de l'Université Masaryk No. 153, 1–29 (1932)

Zahradnicek, J.: *Bemerkungen zum Aufsatz: „Resonanzmethoden für die Bestimmung der Gravitationskonstanten G" von Jacob Kunz, in der Physik. Zeitsch.* **31,** *764, 1930.* Phys. Z. **32,** 149–150 (1932)

Zahradnicek, J.: *Resonanzmethode für die Messung der Gravitationskonstante mittels der Drehwaage.* Phys. Z. **34,** 126–133 (1933)

Zenkov, V. S., Kalinnikov, I. I., Popov, V. M., Sagitov, M. U.: *Effect of a light beam on a high quality torsion balance in vacuum.* Comm. Sternberg Astronomical Inst. No. 191, 35–38 (1974)

2. Comments and Reviews of Measurements of *G*

Armellini, G.: *I problemi fondamentali della cosmogonia e la legge di Newton. Nota I.* Atti della Reala Accademia dei Lincei, Rendiconti **26,** 209–215 (1937)

Armellini, G.: *I problemi fondamentali della cosmogonia e la legge di Newton. Nota II.* Atti della Reala Accademia dei Lincei, Rendiconti **27,** 609–614 (1938)

Aspden, H.: *Charge induction by thermal radiation.* J. Electrostatics **13,** 71–80 (1982)

Babinet, J.: *Note sur le calcul de l'expérience de Cavendish, relative à la masse et à la densité moyenne de la terre.* Cosmos **24,** 543–545 (1864)

Beams, J. W.: *Measuring G: the author comments.* Phys. Today **24**(12), 11–12 (1971)

Bender, P. L.: *Space experiments report of workshop C2.* In: *General Relativity and Gravitation,* edited by B. Bertotti et al., Dordrecht, Reidel 387–395 (1984)

Brandes, H. W.*: *Theoretische Untersuchungen über die Oscillationen der Drehwaage bei Cavendish's Versuchen über die Attraction kleiner Massen.* Mag. für den neuesten Zustand der Naturkunde **12,** 300–310 (1806)

Brillouin, M.*: *Essai sur les lois d'élasticité d'un milieu capable de transmettre des actions en raison inverse du carré de la distance.* Ann. de l'Ecole Normale (1887)

Brillouin, M.: *Constante de la gravitation universelle. Sur une cause de dissymétrie dans l'emploi de la balance de Cavendish.* C.R. Acad. Sci. **131,** 1293–1296 (1900)

Bullen, K. E.: *The Earth's Density,* London, Chapman and Hall, 420 pp (1975)

Champion, F. C. and Davy, N.: *The Newtonian constant of gravitation.* In: *Properties of Matter, 3rd ed.,* New York, Philosophical Library (Chapter 3) 38–52 (1959)

Chazy, J.: *Sur la vitesse de propagation de l'attraction.* C.R. Acad. Sci. **190,** 1273–1275 (1930)

Chazy, J.: *Sur la vitesse de propagation de l'attraction.* C.R. Acad. Sci. **191,** 761–763 (1930)

Chazy, J.: *Sur une loi corrective de la loi de Newton.* C.R. Acad. Sci. **209,** 133–136 (1939)

Chazy, J.: *Sur une loi corrective de la loi de Newton.* C.R. Acad. Sci. **210,** 713–716 (1940)

Chick, H. J.: *Theory of Gravitation 1959–1963 (Bibliography).* Los Alamos Scientific Laboratory Report No. LA(MS)-3099, Sept 1 (unpublished), 67 pp (1964)

Clarke, R. G. S.: *The Constant Concern,* Cambridge University Press, submitted for publication

Cohen, E. R. and Taylor, B. N.: *The 1973 least-squares adjustment of the fundamental constants.* J. Phys. Chem. Ref. Data **2,** 663–734 (1973)

Cohen, E. R. and Taylor, B. N.: *The 1986 Adjustment of the Fundamental Physical Constants.* Codata Bulletin No. 63, Oxford, New York, Pergamon Press 1986

Colavita, P. A.: *Measuring G.* Phys. Today **24**(12), 11 (1971)

Davies, P. C. W.: *Experimenting with controlled gravity.* Nature (London) **268,** 397–398 (1977)

De Boer, H.: *Experiments relating to the gravitational constant.* In: *Precision Measurement and Fundamental Constants II,* edited by B. N. Taylor and W. D. Phillips, National Bureau of Standards Publication 617, Washington, D.C., U.S. Government Printing Office 561–572 (1984)

Drobisch, M. W.: *Über die in den Minen von Dolcoath in Cornwall neuerlich angestellten Pendelbeobachtungen.* Ann. Phys. (Leipzig) **10,** 444–456 (1827)

Drobisch, M. W.: *Ausführlicher Bericht über mehrere in den Jahren 1826 und 1828 in den Minen von Dolcoath in Cornwall zur Bestimmung der mittleren Dichtigkeit der Erde angestellte Pendelversuche.* Ann. Phys. **14,** 409–427 (1828)

Everitt, C. W. F.: *Gravitation, relativity and precise experimentation.* In: *Proc. of the First Marcel Grossmann Meeting on General Relativity,* edited by Remo Ruffini, Amsterdam, North Holland 545–615 (1977)

Folie, F.*: *Sur le calcul de la densité moyenne de la terre, d'après les observations d'Airy.* Bull. Acad. Roy. Belgique **33,** 369–372 (1872)

Folie, F.*: *Sur le calcul de la densité moyenne de la terre, d'après les observations d'Airy.* Bull. Acad. Roy. Belgique **33,** 389–409 (1872)

Fresdorf, G.*: *Die Methoden zur Bestimmung der mittleren Dichte der Erde.* In: *Wissenschaftliche Beilage zum Jahresbericht des Gymnasium zu Weißenburg in Elsaß,* Weißenburg, Germany (1894)

Gaskell, T. H., Bullerwell, W., Cook, A. H., Wyckoff, R. D.: *Gravitation.* In: *Encyclopedia Britannica, 14th ed., v. 10,* New York, Helen Hemingway Benton 711–727 (1972)

Gilbert, L. W.: *Bericht von einer lithologischen Aufnahme des Schehallian, um das specifische Gewicht der Gebirgsarten desselben, und daraus die mittlere Dichtigkeit der Erde zu bestimmen von J. Playfair.* Ann. Phys. **43,** 62–75 (1813)

Gillies, G. T.: *The Newtonian Graviational Constant: An Index of Measurements,* Rapport BIPM-82/9, 83 pp (1982)

Gillies, G. T.: *The Newtonian Gravitational Constant: An Index of Measurements (1983 Edition),* Rapport BIPM-83/1, 135 pp (1983)

Gillies, G. T.: *A survey of experimental research on newtonian gravity.* Bull. Am. Phys. Soc. **31,** 805 (1986)

Gillies, G. T.: *Gravitational-constant data.* Phys. Today **39**(6), 124 (1986)

Gillies, G. T.: *The limits of scientific endeavor: measurements of Newton's G.* Bull. Am. Phys. Soc. **31,** 1766 (1986)

Giulio, C. I.: *Sur la détermination de la densité moyenne de la terre, déduite de l'observation du pendule faite à l'hospice du Mont-Cenis* par M. Carlini en septembre 1821. Mem. Acad. Torino 2, 379–384 (1840)

Gore, J. H.: *Earth, density of.* In: *A Bibliography of Geodesy, U.S. Coast and Geodetic Survey, Appendix 16,* Washington, D.C., U.S. Government Printing Office 366–367 (1887)

Gore, J. H.: *Earth, density of.* In: *A Bibliography of Geodesy, 2nd ed., U.S. Coast and Geodetic Survey Annual Report, Appendix 8,* Washington, D.C., U.S. Government Printing Office 516–518 (1902)

Haupt, E. and Take, E.: *Untersuchungen der bei der Bestimmung der Grvitationskonstante in Spandau benutzten Materialien.* Z. für Instrumentenkunde **24,** 185–186 (1904)

Hearn, G. W.: *On the cause of the discrepancies observed by Mr. Baily with the Cavendish apparatus for determining the mean density of the earth.* Philos. Trans. R. Soc. London **137,** 217–229 (1847)

Heyl, P. R.: *Weighing the earth.* Scientific Monthly **20,** 602–606 (1925)

Heyl, P. R.: *What is gravitation?* Scientific Monthly **47,** 114–123 (1938)

Heyl, P. R.: *Gravitation – still a mystery.* Scientific Monthly **78,** 303–306 (1954)

Hicks, W. M.: *On some irregularities in the values of the mean density of the earth as determined by Baily.* Proc. Cambridge Philos. Soc. **5,** 156–161 (1884)

Hooge, F. N. and Poulis, J. A.: *Fundamental limits to the measurements of the gravitational constant G.* Appl. Sci. Res. **33,** 191–195 (1977)

Jacob, W. S.: *On the causes of the great variation among the different measures of the earth's mean density.* Proc. R. Soc. London **8,** 295–299 (1857)

Jacob, W. S.: *On the causes of the great variation among the different measures of the earth's mean density.* Philos. Mag. **13,** 525–528 (1857)

Jeffreys, H.*: *Theory of Probability, 1st ed.,* Oxford, Clarendon Press (1939)

Jeffreys, H.: *The Earth, 5th ed.,* Cambridge University Press (1970)

Knopf, O.*: *Über die Methoden zur Bestimmung der Mittleren Dichtigkeit der Erde,* Jena, Germany (1880)

Kogbetliantz, E.: *Sur la vitesse de propagation de l'attraction.* C.R. Acad. Sci. **186,** 944–946 (1928)

Kogbetliantz, E.: *Sur la vitesse de propagation de l'attraction.* C.R. Acad. Sci **191,** 30–31 (1930)

Kolosnitsyn, N. I. and Mel'nikov, V. N.: *Effects of gravity in precision measurements.* Measurement Techniques **28**(3), 191–196 (1985) [translation of Izmeritel'naya Tekhnika No. 3, 6–8 (1985)]

Laplace, Marquis de: *Sur les altérations que le mouvements des planètes et des comètes peut éprouver par la résistance des milieux qu'elles traversent, et par la transmission successive de la pesanteur.* In: *Oeuvres de Laplace, Vol. 4, Book 10, Chapter 7,* Paris, Imprimerie Royale 355–365 (1845)

Lehmann-Filhés, R.: *Über die Bewegung eines Planeten unter der Annahme einer sich nicht momentan fortpflanzenden Schwerkraft.* Astron. Nachr. **110** (2630), 209–220 (1884)

Lévy, M.: *Sur l'application des lois électrodynamiques au mouvement des planètes.* C.R. Acad. Sci. **110,** 545–551 (1890)

Lier, R. H.: *Theory of Gravitation 1929 to present (Bibliography).* Los Alamos Scientific Laboratory Report No. LAMS-2338, April 20 (unpublished), 155 pp (1960)

Mackenzie, A. S.: *The Laws of Gravitation: Memoirs by Sir Isaac Newton, Pierre Bouguer, and Henry Cavendish together with Abstracts of Other Important Memoirs,* New York, American Book Co. (1900)

Maddox, J.: *Who knows how massive is the earth?* Nature (London) **302,** 11 (1983)

Maddox, J.: *Continuing doubt on gravitation.* Nature (London) **310,** 723 (1984)

Menabrea, L. F.: *Calcul de la densité de la terre.* Bibliothèque Universelle de Genève **27,** 168–175 (1840)

Menabrea, L. F.: *On Cavendish's experiment.* Philos. Mag. **19,** 62–63 (1841)

Muncke, H.: *Dichtigkeit der Erde.* In: *Gehler's Physikalisches Wörterbuch, v. 3E,* Leipzig, E. B. Schwickert Verlag 940–970 (1827)

Nordtvedt, Jr., K., Faller, J. E., Beams, J. W.: *Gravitation.* In: *Encyclopedia Britannica, 15th ed., v. 10,* New York, Helen Hemingway Benton 286–295 (1974)

Oppenheim, M.*: *Zur Frage nach der Fortpflanzungsgeschwindigkeit der Gravitation,* Vienna, Austria (1895)

Peters, C. A. F.: *Von den kleinen Ablenkungen der Lothlinie und des Niveaus, welche durch die Anziehungen der Sonne, des Mondes und einiger terrestrischen Gegenstände hervorgebracht werden.* Astron. Nachr. **22,** 33–42 (1845)

Pipkin, F. M. and Ritter, R. C.: *Precision measurement and fundamental constants.* Science **219,** 913–921 (1983)

Popovici, C.: *Sur une modification de la loi de Newton-Coulomb.* Bull. Astron. (Paris) **3,** 257–261 (1923)

Popovici, C.: *Sur l'énergie de l'attraction éclairée.* C.R. Acad. Sci. **208,** 2052–2054 (1939)

Poulis, J. A. and Hooge, F. N.: *Thermal noise in balances and its significance for physical measurements.* J. Vac. Sci. Technol. **15,** 795–799 (1978)

Poynting, J. H.: *A history of the methods of weighing the earth.* Birmingham Phil. Soc. Proc. **9,** 1–23 (1894)

Poynting, J. H.: *The Mean Density of the Earth – An Essay,* London, Charles Griffin and Co., Ltd., 164 pp (1894)

Poynting, J. H.: *Recent studies in gravitation.* Nature (London) **62,** 403–408 (1900)

Poynting, J. H.: *Recent studies in gravitation.* Proc. R. Institution (G.B.) **16,** 278–294 (1901)

Poynting, J. H.: *Recent studies in gravitation.* In: *Annual Report of the Board of Regents of the Smithsonian Institution,* Washington, D.C., U.S. Government Printing Office 199–214 (1902)

Poynting, J. H. and Thomson, J. J.: *Gravitation.* In: *A Textbook of Physics: Properties of Matter,* London, Charles Griffin and Co., Ltd. (Chapter 3) 28–52 (1902)

Poynting, J. H.: *Gravitation.* In: *Encyclopedia Britannica, 11th ed., v. 12,* New York, Encyclopedia Britannica 384–389 (1910)

Pringle, J.: *A discourse on the attractions of mountains.* In: *Anniversary Meeting of the Royal Society,* London, R. Soc. London, 33 pp (1775)

Pringle, J.: *Discours sur l'attraction des montagnes; traduit par M. le Roy.* J. Phys. (Rozier) **7,** 418–434 (1776)

Roche, E.-A.: *Note sur la loi de la densité à l'intérieur de la terre.* C.R. Acad. Sci. **39,** 1215–1217 (1854)

Roche, E.-A.: *La variation de la pesanteur à l'intérieur de la terre.* Mémoires de l'Académie des Sciences de Montpellier **3,** 107–124 (1857)

Sabine, E.: *An account of Prof. Carlini's experiments on Mont-Cenis.* Quarterly Journal of Science **24,** 153–159 (1827)

Sagitov, M. U.: *The Gravitational Constant and the Mass of the Earth,* Moscow, Nauka 188 pp (1969)

Sagitov, M. U.: *Gravitationskonstante, Masse, und mittlere Dichte der Erde.* Vermessungstechnik **19,** 59–63 (1971)

Sagitov, M. U.: *Current status of determinations of the gravitational constant and the mass of the earth.* Sov. Astron. **13**(4), 712–718 (1976) [translation of Astron. Zh. **46**(4), 907–915 (1969)]

Sagitov, M. U. and Milyukov, V. K.: *The determination of the gravitational constant and its possible spatial and temporal changes: current situation and problems.* Fizikai Szemle (Budapest) **33**(1), 12–24 (1983)

Saigey, J. F.*: *Densité du globe.* Rev. Scient. et Ind. (Quesneville) **11,** 149–160 (1842)
Saigey, J. F.*: *Densité du globe.* Rev. Scient. et Ind. (Quesneville) **12,** 373–388 (1842)
Scheffler, H.: *Über die mittlere Dichtigkeit der Erde.* Z. für Mathematik und Physik **10,** 224–227 (1865)
Schell, A.*: *Über die Bestimmung der mittleren Dichtigkeit der Erde,* Göttingen, Germany (1869)
Sergent, E.: *Sulla densita della materia nell'interno del globe, e sulla potenza della crosta terrestre.* Atti della Soc. Ital. di Sci. Nat. Milano **2,** 169–175 (1859)
Steenbeck, M. and Treder, H.-J.: *Möglichkeiten der experimentellen Schwerkraftforschung.* Veröffentlichungen des Forschungsbereichs Kosmische Physik **11,** 1–48 (1984)
Stegna, L. and Sagitov, M. U.: *The Constant of Gravitation,* Budapest, Hungary, Lorand Eötvös University, Kiado Akadémiai, 255 pp (1979)
Tait, M.*: *Conférences sur quelques-uns des progrès récents de la physique,* Paris, Gauthier-Villars (1887)
Tangl, K.: *Baron Roland von Eötvös zum 70. Geburtstage. Seine Untersuchungen über die Gravitation.* Die Naturwissenschaften **6,** 445–447 (1918)
Thüring, B.: *Studien über die sogenannte Gravitationskonstante.* Ann. der Akademie Scientifische Fennicae **A III**(61), 269–283 (1961)
Thüring, B.: *Studies on the so-called gravitational constant.* Science Abstracts **65,** 1686 (1962)
Tisserand, F.: *Sur le mouvement des planètes autour du Soleil, d'après la loi électrodynamique de Weber.* C. R. Acad. Sci. **75,** 760–763 (1872)
Tisserand, F.: *Sur les mouvements des planètes, en supposant l'attraction représentée par l'une des lois électrodynamiques de Gauss ou de Weber.* C. R. Acad. Sci. **110,** 313–315 (1890)
Tisserand, F.: *Vitesse de propagation de l'attraction.* In: *Traité de Mécanique Céleste, Vol. 4, Chap. 28,* Paris, Gauthier-Villars 494–511 (1896)
Van Dijk, H. H. J., Poulis, J. A., Hooge, F. N.: *Noise in weighing.* Appl. Sci. Res. **31,** 445–454 (1976)
Von Hepperger, M.*: Sitzungsberichte der Akademie von Wissenschaft zu Wien (1888)
Von Zach, F. X.*: *Über die Möglichkeit die Gestalt der Erde aus Gradmessungen zu bestimmen.* Monatliche Correspondanz **20,** 3–9 (1809)
Von Zach, F. X.*: *Über die Densität der Erde und deren Einfluß auf geographische Ortsbestimmungen.* Monatliche Correspondanz **21,** 293–310 (1810)
Von Zach, F. X.*: *L'Attraction des Montagnes, et ses Effets sur les Fils à Plomb ou sur les Niveaux des Instruments d'Astronomie, 2 v.,* Avignon, France (1814)
Wallentin, J. G.: *Über die Methoden zur Bestimmung der mittleren Dichte der Erde und eine neue diesbezügliche Anwendung der Waage.* Humboldt **1,** 212–217 (1882)
Worden, Jr., P. W. and Everitt, C. W. F.: *Resource letter GI-1: gravity and inertia.* Am. J. Phys. **50,** 494–500 (1982)
Young, T.: *Remarks on the probabilities of error in physical observations, and on the density of the earth, considered, especially with regard to the reduction of experiments on the pendulum. In a letter to Captain Henry Kater.* Philos. Trans. R. Soc. London **109,** 70–95 (1819)
Young, T.*: *Miscellaneous Works and Life, 4 v.,* London, Peacock and Lietch (1855)
Zanotti-Bianco, O.*: *Il Problema Meccanico della Figura della Terra, 2 parts,* Florence, Italy (1880)
Zöllner, M.*: *Principien einer electrodynamischen Theorie der Materie,* Leipzig (1876)

3. Measurements of Gravitational Permeability, Absorption and Shielding

Adămuţi, I. A.*: *Sur la possibilitié d'une interprétation électromagnétique du champ gravitationnel pour des systèmes immobiles.* Mémoires, Conseil National de la Recherche Scientifique No. 0049960 (1958)
Adămuţi, I. A.*: *Sur la possibilité d'une interprétation électromagnétique du champ gravitationnel pour des système immobiles.* Academiei Republicii Socialiste Romania, No. 22627 (1968)
Adămuţi, I. A.*: *Sur la possibilité d'une interprétation électromagnétique du champ gravitationnel pour des systèmes immobiles.* Mémoires. Conseil National de la Recherche Scientifique, No. 498 (1969)
Adămuţi, I. A.*: *Beiträge zur Newtonschen Gravitation.* **57,** (1969) unpublished
Adămuţi, I. A.: *Analyse de l'action gravitationnelle du rayonnement électromagnétique sur un système de corps. Une théorie électrothermodynamique de la gravitation.* Nuovo Cimento B **32,** 477–513 (1976)
Adămuţi, I. A.: *The screen effect of the earth in the TETG. (Theory of a screening experiment of a sample body at the equator, using the earth as a screen).* Nuovo Cimento C **5,** 189–208 (1982)
Allais, M. F. C.: *Test de périodicité. Généralisation du test de Schuster au cas de séries temporelles autocorrélées.* C. R. Acad. Sci. **244,** 2469–2471 (1957)
Allais, M. F. C.: *Observation des mouvements du pendule paraconique.* C. R. Acad. Sci. **245,** 1697–1700 (1957)
Allais, M. F. C.: *Analyse harmonique des mouvements du pendule paraconique.* C. R. Acad. Sci. **245,** 1875–1878 (1957)
Allais, M. F. C.: *Mouvements du pendule paraconique et éclipse totale de soleil du 30 juin 1954.* C. R. Acad. Sci. **245,** 2001–2003 (1957)
Allais, M. F. C.: *Théorie du pendule paraconique et influence lunisolaire.* C. R. Acad. Sci. **245,** 2170–2173 (1957)
Allais, M. F. C.: *Application du test de Schuster généralisé à l'analyse harmonique des azimuts du pendule paraconique.* C. R. Acad. Sci. **245,** 2467–2470 (1957)
Allais, M. F. C.: *Doit-on reconsidérer les lois de la gravitation?* Perspectives X **31,** 90–104 (1958)
Allais, M. F. C.: *Nouvelles expériences sur le pendule paraconique à support anisotrope.* C. R. Acad. Sci. **247,** 1428–1431 (1958)
Allais, M. F. C.: *Structure périodique des mouvements du pendule paraconique à support anisotrope à Bougival et Saint-Germain en juillet 1958.* C. R. Acad. Sci. **247,** 2284–2287 (1958)

Allais, M. F. C.: *Should the laws of gravitation be reconsidered? Part I. Abnormalities in the motion of a paraconical pendulum on an anisotropic support.* Aerospace Engineering, 18 September 1959, 46–52

Allais, M. F. C.: *Should the laws of gravitation be reconsidered? Part II. Experiments in connection with the abnormalities noted in the motion of the paraconical pendulum with an anisotropic support.* Aerospace Engineering, 18 October 1959, 51–55

Allais, M. F. C.*: *Should the laws of gravitation be reconsidered?* Aerospace Engineering, 18 November 1959, 55

Allen, M. and Saxl, E. J.: *Elastic torsion in wires under tension.* J. Appl. Phys. **40,** 2505–2509 (1969)

Armellini, G.: *Il moto del perielio di mercurio nell'ipotesi di un assorbimento del flusso gravitazionale attraverso i mezzo materiali.* Atti della Reale Accademia dei Lincei, Rendiconti **5,** 288–294 (1948)

Arrhenius, S.: *Die Unendlichkeit der Welt.* Rivista di Scienza **5,** 217–229 (1909)

Austin, L. W. and Thwing, C. B.: *An experimental research on gravitational permeability.* Phys. Rev. **5,** 294–300 (1897)

Banna, P.*: *Interpretazioni nella gravitazione universale.* Tekne Messina (1958/1959)

Banna, P.*: *Lineamenti dell'universo fisico.* Tekne Messina (1962)

Bocchio, F.: *Old and new approaches in the study of gravitational absorption.* Geophys. J. R. Astron. Soc. **24,** 101–102 (1971)

Bocchio, F.: *On the effects of gravitational absorption on orbits of artificial earth satellites.* Memorie della Societa Astronomica Italiana **42,** 131–143 (1971)

Bock, M.*: *Die Theorie der Gravitation von Isenkrahe in ihrer Anwendung auf die Anziehung und Bewegung der Himmelskörper.* Munich (1891)

Bottlinger, K. F.*: *Die Gravitationstheorie und die Bewegung des Mondes.* Dissertation, University of Munich, Freiburg, Germany, C. Troemer Verlag, 57 pp. (1912)

Bottlinger, K. F.: *Zur Frage der Absorption der Gravitation.* Sitzungsberichte der Mathematisch-Physikalischen Klasse der Königlich Bayerischen Akademie der Wissenschaften zu München **44,** 223–239 (1914)

Braginsky, V. B., Rudenko, V. N., Rukman, G. I.: *An experimental investigation of an intermediate medium on gravitational interaction.* Sov. Phys. – JETP **16,** 36–41 (1963) [translation of Zh. Eksp. Teor. Fiz. **43,** 51–58 (July 1962)]

Braginsky, V. B. and Martynov, V. K.: *Investigation of the effect of intermediate bodies on gravitational interaction.* Moscow Univ. Phys. Bull. **21**(2), 35–40 (1968) [translation of Vest. Mosk. Univ., Fiz. **21**(2), 60–68 (1966)]

Brein, R.: *Die Schwerkraftregistrierungen. Beitrag zur Frage einer Absorption der Schwere. Deutsche Geodätische Kommission bei der Bayerischen Akademie der Wissenschaften, Reihe B: Angewandte Geodäsie – Heft Nr. 34, Mitteilung Nr. 16 des Instituts für Angewandte Geodäsie (Abteilung II des Deutschen Geodätischen Forschungsinstituts).* 30–45 (1957)

Caputo, M.: *Observations taken at Trieste, with the great horizontal pendulums at the time of the solar eclipse of February, 1961.* In: Quatrième Symposium International sur les Marées Terrestres, edited by Paul Melchior, Communications de l'Observatoire Royal de Belgique, No. 188, Série Géophysique No. 58, Brussels, Belgium 64–65 (1961)

Caputo, M.: *Un nuovo limite superiore per il coefficiente di assorbimento della gravitazione.* Atti della Reale Accademia di Lincei, Rendiconti **32,** 509–515 (1962)

Caputo, M.: *Experiments concerning gravitational shielding.* In: *Gravitazione Sperimentale,* edited by Bruno Bertotti, Atti dei Convegni Lincei, Vol. 34, Rome, Accademia Nazionale de Lincei 193–212 (1977)

Cerofolini, G. F.: Quantum mechanics and gravitation. Lett. Nuovo Cimento **23,** 509–512 (1978)

Cremieu, V.: *Attraction observée entre gouttes liquides suspendues dans un liquide de même densité.* C. R. Acad. Sci. **140,** 80–83 (1905)

Cremieu, V.: *Recherches sur la gravitation.* C. R. Acad. Sci. **141,** 653–656 (1905)

Cremieu, V.: *Recherches sur la gravitation.* C. R. Acad. Sci. **141,** 713–715 (1905)

Cremieu, V.: *Recherches experimentales sur la gravitation.* Soc. Française de Physique, Bull. Séances, November 17, 485–499 (1905)

Cremieu, V.: *Recherches sur la gravitation.* C. R. Acad. Sci. **143,** 887–889 (1906)

Cremieu, V.: *Recherches sur la gravitation.* J. Phys. (Paris) **5,** 25–39 (1906)

Cremieu, V.: *Recherches comparées sur les forces de gravitation dans les gaz et les liquides.* Soc. Française de Physique, Bull. Séances, February 1, 33–47 (1907)

Cremieu, V.: *Recherches comparées sur les forces de gravitation dans les gaz et les liquides.* J. Phys. (Paris) **6,** 284–298 (1907)

Cremieu, V.: *Le problème de la gravitation.* Rev. Gén. Sci. Pur. et Appl. **18,** 7–13 (1907)

Cremieu, V.: *Emploi de la balance de torsion comme sismographe.* C. R. Acad. Sci. **148,** 1161–1163 (1909)

Cremieu, V.: *Détermination nouvelle de la constante Newtonienne.* C. R. Acad. Sci. **149,** 700–702 (1909)

Cremieu, V.: *Sur une erreur systématique qui limite la précision de l'expérience de Cavendish. Méthode nouvelle pour l'étude de la gravitation.* C. R. Acad. Sci. **150,** 863–866 (1910)

Cremieu, V.: *Effets de la flexion aux points d'attache du fil d'une balance de torsion.* C. R. Acad. Sci. **156,** 617–620 (1913)

Cremieu, V.: *Recherches expérimentales sur la gravitation.* C. R. Acad. Sci. **165,** 586–589, 688(E) (1917)

Cremieu, V.: *Nouvelles recherches expérimentales sur la gravitation.* C. R. Acad. Sci. **165,** 670–672 (1917)

Crowley, R. J., Woodward, J. F., Yourgrau, W.: *Gravitational attenuation and the internal heating of planetary bodies.* Astron. Nachr. **295**(5), 203–206 (1974)

De Sitter, W.*: *The absorption of gravity and the longitude of the moon.* Amsterdam Proceedings **21** (1912)

De Sitter, W.: *Absorption of gravitation.* The Observatory **35,** 387–393 (1912)

Dobrokhotov, Yu. S., Pariisky, N. N., Lysenko, V. I.: *Observations of tidal variations of gravity in Kiev during the solar eclipse of February 15, 1961.* In: *Quatrième Symposium International sur les Marées Terrestres,* edited by Paul Melchior, Communications de l'Observatoire Royal de Belgique, No. 188, Série Géophysique No. 58, Brussels, Belgium 66–68 (1961)

Eddington, A. S.: *Majorana's theory of gravitation.* Astrophys. J. **56,** 71–72 (1922)

Eichelberger, W. S. and Morgan, H. R.: *On the daily variation in clock corrections.* Astron. J. **34,** 15–17 (1922)

Eötvös, R.: *Etude sur les surfaces de niveau et la variation de la pesanteur et du champ magnétique.* In: *Rapports présentés au Congrès International de Physique, v. 3,* Paris, Gauthier-Villars, 371–393 (1900)

Erismann, T.: *Zur Frage nach der Abhängigkeit der Gravitationskraft vom Zwischenmedium.* Vierteljahrsschrift der Naturforschenden Gesellschaft in Zürich **53,** 157–185 (1908)

Erismann, T.: *Sur la dépendance de la force de gravitation du milieu intermédiaire à travers lequel elle s'exerce.* Arch. Sci. Phys. Nat. **31,** 36–45 (1911)

Flint, F. V.*: *Should the laws of gravitation be reconsidered? Discussion.* Aerospace Engineering, **19,** 113–114 (May 1960)

Forward, R. L.: *General relativity for the experimentalist.* Proc. Inst. Radio Eng. **49,** 892–904 (1961)

Groten, E.: *The problem of gravitational absorption.* Geophys. J. R. Astron. Soc. **27,** 447–448 (1972)

Gruschinsky, N. P. and Sagitov, M. U.: *Observations of gravity during a total solar eclipse.* In: *Abstracts of the 1st Soviet Conference on Gravitation,* Moscow University 177 (1961)

Gruschinsky, N. P. and Sagitov, M. U.: *The observation of gravity during the solar eclipse.* Vest. Mosk. Univ. Fiz. No. 5, 46–53 (1962)

Harrington, E. A.: *Further experiments on the continuous generation of heat in certain silicates.* Proc. Am. Philos. Soc. **72,** 333–349 (1933)

Harrison, J. C.: *A note on the paper 'Earth-tide observations made during the international geophysical year'.* J. Geophys. Res. **68**(5), 1517–1518 (1963)

Heyl, P. R.: *Gravitational absorption.* Science **55,** 349–350 (1922)

Hoffmann, B.: *Noon-midnight red shift.* Phys. Rev. **121,** 337–342 (1961)

Isenkrahe, C.*: *Das Räthsel von der Schwerkraft.* Braunschweig (1879)

Isenkrahe, C.: *Über die Zurückführung der Schwere auf Absorption und die daraus abgeleiteten Gesetze.* Abhandlungen zur Gesellschaft der Mathematik und Physik (Zeitschrift für Mathematik und Physik) **37** (Anhang), 163–204 (1892)

Kagal'nikova, N. N. Radzievskii, V. V., Chernikov, Yu. A., Chernyshov, V. I., Shuvalov, V. V.: *On the observation of gravitational effect of the solar eclipse of February 15, 1961 according to observations made in Yaroslavl.* Vsesoyuznoye Astronomo-geodezicheskoye Obshchestvo., Byulleten, No. 31, 15–17 (1962)

Kleiner, A.: *Gravitation considérée comme une force se faisant sentir de proche en proche.* Arch. Sci. Phys. Nat. **20,** 420–423 (1905)

Klutz, H.*: *The Lesagian theory of gravitation.* Technical Engineering News **35**(1), 28–59 (1953)

Kolesnikov, S. M., Kolesnikova, E. M., Maslov, E. M., Stavskii, A. K.: *Observation of non-Newtonian gravitation effects.* Probl. Teorii Gravitatsii i Elem. Chastits (USSR), No. 5 192–199 (1974)

Kostko, O.: *Is a gravity screen possible?* Foreign Translation Division Technical Report No. FTD-TT-63-155/1, Wright-Patterson Air Force Base, Ohio, April 25, 7 pp. (1963) [translation of Zarya Vostoka, January 5, 4 (1963)]

Laager, F.: *Versuch mit der Drehwage die Abhängigkeit der Gravitation vom Zwischenmedium nachzuweisen.* Dissertation, Univ. Zurich, Bern, Switzerland, Haller'sche Buchdruckerei, 34 pp. (1904)

Liakhovets, V. D.*: *The possibilities of the experiment within the gravitational theory of Le Sage.* In: *Problems of Statistical and Quantum Physics,* Moscow, People's Friendship University, 140–145 (1983)

Liakhovets, V. D.: *Evidence for Majorana's theory of gravitation.* In: *Abstracts of the 11th International Conference on General Relativity and Gravitation, Vol. 1,* Stockholm, 92 (1986)

Library of congress: *Gravitation Experiments.* In: *Detection and Generation of Gravitational Waves, Part III,* Aerospace Information Division Report No. P-63-77, May 24, 18–32 (1963)

Likhosherstnyh, D. U.*: *The use of gravimetrical data and movement of the planet's natural satellites for the determination of the upper limit of the gravitation screen coefficient.* In: *Theory of Relativity and Gravitation,* Moscow 47–51 (1971)

Majorana, Q.: *Expériences sur la gravitation.* C. R. Acad. Sci. **169,** 719–721 (1919)

Majorana, Q.: *Sulla gravitazione.* Atti della Reala Accademia dei Lincei, Rendiconti **28,** 165–174 (1919). (The name of this journal will be abbreviated for the remainder of Prof. Majorana's entries)

Majorana, Q.: *Sulla gravitazione.* Atti Accad. Lincei **28,** 221–223 (1919)

Majorana, Q.: *Sulla gravitazione.* Atti Accad. Lincei **28,** 313–317 (1919)

Majorana, Q.: *Sulla gravitazione.* Atti Accad. Lincei **28,** 416–421 (1979)

Majorana, Q.: *Sulla gravitazione.* Atti Accad. Lincei **28,** 480–489 (1919)

Majorana, Q.: *Sur la gravitation.* C. R. Acad. Sci. **169,** 646–649 (1919)

Majorana, Q.: *Sulla gravitazione.* Atti Accad. Lincei **29,** 23–32 (1920)

Majorana, Q.: *Sulla gravitazione.* Atti Accad. Lincei **29,** 90–99 (1920)

Majorana, Q.: *Sulla gravitazione.* Atti Accad. Lincei **29,** 163–169 (1920)

Majorana, Q.: *Sulla gravitazione.* Atti Accad. Lincei **29,** 235–240 (1920)

Majorana, Q.: *On gravitation. Theoretical and experimental researches.* Philos. Mag. **39,** 488–504 (1920)

Majorana, Q.: *Sull'assorbimento della gravitazione.* Atti Accad. Lincei **30**, 75–79 (1921)
Majorana, Q.: *Sull'assorbimento della gravitazione.* Atti Accad. Lincei **30**, 289–294 (1921)
Majorana, Q.: *Sull'assorbimento della gravitazione.* Atti Accad. Lincei **30**, 350–354 (1921)
Majorana, Q.: *Sull'assorbimento della gravitazione.* Atti Accad. Lincei **30**, 442–446 (1921)
Majorana, Q.: *Sur l'absorption de la gravitation.* C. R. Acad. Sci. **173**, 478–479 (1921)
Majorana, Q.: *Sull'assorbimento della gravitazione.* Atti Accad. Lincei **31**, 41–45 (1922)
Majorana, Q.: *Sull'assorbimento della gravitazione.* Atti Accad. Lincei **31**, 81–86 (1922)
Majorana, Q.: *Sull'assorbimento della gravitazione.* Atti Accad. Lincei **31**, 141–146 (1922)
Majorana, Q.: *Sull'assorbimento della gravitazione.* Atti Accad. Lincei **31**, 221–226 (1922)
Majorana, Q.: *Sull'assorbimento della gravitazione.* Atti Accad. Lincei **31**, 343–346 (1922)
Majorana, Q.: *Quelques recherches sur l'absorption de la gravitation.* J. Phys. Radium **1**, 314–324 (1930)
Majorana, Q.: *Su di un'ipotesi cosmogonica.* Atti Accad. Lincei **17**, 150–157 (1954)
Majorana, Q.: *Su di una nuova teoria della gravitazione.* Atti Accad. Lincei **19**, 95–101 (1955)
Majorana, Q.: *Sull'ipotesi dell'assorbimento gravitazionale.* Atti Accad. Lincei **22**, 392–397 (1957)
Majorana, Q.: *Ipotetiche consequenze dell'assorbimento gravitazionale.* Atti Accad. Lincei **22**, 397–402 (1957)
Radzievskii, V. V. and Kagal'nikova, I. I.: *The nature of gravitation.* Vsesoyuznoye Astronomo-geodezicheskoye Obshchestvo. Byulleten, No. 26, 3–14 (1960)
Radzievskii, V. V.*: *Absorption of gravity and experimental measurement of the absorption coefficient.* In: *Abstracts of the 1st Soviet Conference on Gravitation,* Moscow, Moscow University 178–179 (1961)
Radzievskii, V. V.: *Two inclinometers for measurement of the gravitational effect.* Vsesoyuznoye Astronomo-geodezicheskoye Obshchestvo. Byulleten, No. 31, 3–14 (1962)
Russel, H. N.: *On Majorana's theory of gravitation.* Astrophys. J. **54**, 334–346 (1921)
Saxl, E. J. and Allen, M.: *Period of a torsion pendulum as affected by adding weights.* J. Appl. Phys. **40**, 2499–2504 (1969)
Saxl, E. J. and Allen, M.: *1970 solar eclipse as 'seen' by a torsion pendulum.* Phys. Rev. D **3**, 823–825 (1971)
Schlomka, T.: *Über die Abhängigkeit der Schwerkraft vom Zwischenmedium.* Z. für Geophys. 397–400 (1927)
Schneiderov, A. J.: *On a criticism of Majorana's theory of gravitation.* Bollettino di Geofisica Teorica ed Applicata **3**, 77–79 (1961)
Sigl, R. and Eberhard, O.: *Horizontalpendelbeobachtungen in Berchtesgaden während der Sonnenfinsternis vom 15. 2. 1961.* In: *Quatrième Symposium International sur les Marées Terrestres,* edited by Paul Melchoir, Communications de l'Observatoire Royal de Belgique, No. 188, Série Géophysique No. 58, Brussels, Belgium 70–75 (1961)
Slichter, L. B., Caputo, M., Hager, C. L.: *An experiment concerning gravitational shielding.* J. Geophys. Res. **70**(6), 1541–1551 (1965)
Tiron, M.: *Gravitation.* Foreign Technology Division Translation Division Technical Report No. FTD-TT-62-1217, Wright-Patterson Air Force Base, Ohio, October 9, 1–8 (1962) [translation of Stiinta Si Tehnica, **14**(4), 14–17 (1962)]
Tomaschek, R.: *Tidal gravity measurements in the Shetlands. Effect of the total eclipse of June 30, 1954.* Nature (London) **175**, 937–939 (1955)
Tomaschek, R.: *Conditions d'observation de l'éclipse de soleil du 15 février 1961 pour les instruments de mesure des marées terrestres.* Marées Terrestres Bulletin d'Information, No. 23, 3 janvier 460–465 (bis) (1961)
Tomaschek, R. and Groten, E.: *Untersuchung von Gravitationswirkungen während der totalen Sonnenfinsternis am 15. Februar 1961.* Nachrichten aus dem Karten- und Vermessungswesen, Reihe I: Deutsche Beiträge und Informationenheft Nr. 25, Frankfurt a. M., Germany, Verlag des Instituts für Angewandte Geodäsie 17–26 (1963)
Veselov, K. E.*: *Accidental coincidences or natural phenomenon.* Geophysical Journal of the Academy of Sciences of the Ukranian SSR, **3**(3), 50–61 (1981)
Von Seeliger, H.: *Über die Anwendung der Naturgesetze auf das Universum (abstract).* Sitzungsberichte der Mathematisch-Physikalischen Klasse der Königlich Bayerischen Akademie der Wissenschaften zu München 18 (1909)
Von Seeliger, H.: *Über die Anwendung der Naturgesetze auf das Universum.* Sitzungsberichte der Königlich Bayerischen Akademie der Wissenschaften, Mathematisch-Physikalische Klasse, 4. Abhandlung, May 1, 25 pp. (1909)
Weber, J.: *Gravitational shielding and absorption.* Phys. Rev. **146**, 935–937 (1966)
Yarkovsky, P. O.*: *World Gravitation as a Result of the Formation of Weighable Matter Inside the Celestial Bodies.* Moscow (1889)

4. Measurements of the Local Directive Action of the Gravitational Force

Heyl, P. R.: *Gravitational anisotropy in crystals.* Scientific Papers of the Bureau of Standards (U.S.) **19**, 307–324 (1924)
Mackenzie, A. S.: *On the attractions of crystalline and isotropic masses at small distances.* Phys. Rev. **2**, 321–343 (1985)
Poynting, J. H. and Gray, P. L.: *An experiment in search of a directive action of one quartz crystal on another.* Proc. R. Soc. London, Ser. A **64**, 121–122 (1898)
Poynting, J. H. and Gray, P. L.: *An experiment in search of a directive action of one quartz crystal on another.* Philos. Trans. R. Soc. London, Ser. A **192**, 245–256 (1899)

Zeeman, P.: *Some experiments on gravitation. The ratio of mass to weight for crystals and radioactive substances.* Proceedings of the Section of Sciences, Koninklijke Akademie van Wetenschappen te Amsterdam **20,** 542–553 (1918)

5. Measurements of the Dependence of *G* on the Physical State of Masses

Cook, A. H.: *A new determination of the constant of gravitation.* Contemp. Phys. **9,** 227–238 (1968)

Cowsik, R.: *A new torsion balance for studies in gravitation and cosmology.* Indian J. Phys. **55 B,** 497–502 (1981)

Cremieu, V.: *Recherches comparées sur les forces de gravitation dans les gaz et les liquides.* J. Phys. (Paris) **6,** 284–298 (1907)

Eötvös, R.: *Über die Anziehung der Erde auf verschiedene Substanzen.* Akadémiai Ertesitö **1,** 108–110 (1890)

Eötvös, R.: *Über die Anziehung der Erde auf verschiedene Substanzen.* Mathematische und Naturwissenschaftliche Berichte aus Ungarn **8,** 65–68 (1891)

Eötvös, R.: *Über die Anziehung der Erde auf verschiedene Substanzen.* Beiblätter für Physik **15,** 688–689 (1891)

Kriechgauer, Hr.*: Verhandlungen der Berliner Physikalischen Gesellschaft **10,** 13 (1892)

Lee, W. N.: *A preliminary analysis of the effects of using nonspherical masses in a Beams-type measurement of G or $\Delta G/G$.* M. I. T. Measurement Systems Laboratory Report No. RE-74, NASA Contractor Report No. CR-115139, Cambridge, Mass., M. I. T. 44 pp. (1970)

Mills, Jr., A. P.: *Proposed null experiments to test the inverse square law of gravitation.* Gen. Relativ. Gravit. **11,** 1–11 (1979)

Metherell, A. J. F., Speake, C. C., Chen, Y. T., Faller, J. E.: *Optimizing the shape of the attracting mass in precision measurements of G.* In: *Precision Measurement and Fundamental Constants II,* edited by B. N. Taylor and W. D. Phillips, National Bureau of Standards Special Publication 617, Washington, D.C., U.S. Government Printing Office, 581–585 (1984)

6. Measurements of the Dependence of *G* on the Chemical State of Masses

Bartlett, D. F. and Van Buren, D.: *Equivalence of active and passive gravitational mass using the moon.* Phys. Rev. Lett. **57,** 21–24 (1986)

Bartlett, D. F. and Van Buren, D.: *Asymmetry of the moon and the equivalence of active and passive gravitational mass.* In: *Abstracts of the 11th Conference on General Relativity and Gravitation,* Stockholm 608 (1986)

Brush, C. F.: *Discussion of a kinetic theory of gravitation, II, and some new experiments in gravitation.* Phys. Rev. **18,** 125–126 (1921)

Brush, C. F.: *Discussion of a kinetic theory of gravitation, II, and some new experiments in gravitation.* Proc. Am. Philos. Soc. **60,** 43–61 (1921)

Brush, C. F.: *Discussion of a kinetic theory of gravitation, II, and some new experiments in gravitation. Second paper.* Proc. Am. Philos. Soc. **61,** 167–183 (1922)

Brush, C. F.: *Discussion of a kinetic theory of gravitation, II, and some new experiments in gravitation. Third paper.* Proc. Am. Philos. Soc. **62,** 75–89 (1923)

Brush, C. F.: *Some new experiments in gravitation. Fourth paper.* Proc. Am. Philos. Soc. **63,** 57–61 (1924)

Brush, C. F.: *Some experimental evidence supporting the kinetic theory of gravitation.* J. Franklin Institute **206,** 143–149 (1928)

Burton, C. V.: *The possible dependence of gravitational attraction on chemical composition, and the fluctuations of the moon's longitude which might result therefrom.* Philos. Mag. **28,** 252–256 (1914)

Eötvös, R., Pekar, D., Fekete, E.: *Beiträge zum Gesetze der Proportionalität von Trägheit und Gravität.* Ann. Phys. (Leipzig) **68,** 11–66 (1922)

Eötvös, R., Pekar, D, Fekete, E.: *Beiträge zum Gesetze der Proportionalität von Trägheit und Gravität.* In: *Gesammelte Arbeiten,* edited by P. Selényi, Budapest, Akadémiai, Kiado 25–68 (1953)

Gilvarry, J. J. and Muller, P. M.: *Possible variation of the gravitational constant over the elements.* Phys. Rev. Lett. **28,** 1665–1669 (1972)

Koester, L.: *Verification of the equivalence of gravitational and inertial mass for the neutron.* Phys. Rev. D **14,** 907–909 (1976)

Kreuzer, L. B.: *The equivalence of active and passive gravitational mass.* Ph. D. Thesis, Princeton University 107 pp. (1966)

Kreuzer, L. B.: *Experimental measurement of the equivalence of active and passive gravitational mass.* Phys. Rev. **169,** 1007–1012 (1968)

Landolt, H.: *Untersuchungen über etwaige Änderungen des Gesamtgewichtes chemisch sich umsetzender Körper.* Sitzungsberichte der Königlich Preußischen Akademie der Wissenschaften zu Berlin, No. 22 301–334 (1893)

Landolt, H.: *Untersuchungen über etwaige Änderungen des Gesamtgewichtes chemisch sich umsetzender Körper.* Z. Phys. Chem. **12,** 1–34 (1893)

Morrison, D. and Hill, H. A.: *Current uncertainty in the ratio of the active-to-passive gravitational mass.* Phys. Rev. D **8,** 2731–2733 (1973)

Potter, H. H.: *Note on the gravitational acceleration of bismuth.* Phys. Rev. **19,** 187–188 (1922)

Potter, H. H.: *Some experiments on the proportionality of mass and weight.* Proc. R. Soc. London, Ser. A **104,** 588–610 (1923)

Sanford, F. and Ray, L. E.: *On a possible change of weight in chemical reactions.* Phys. Rev. **5,** 247–253 (1897)

Wapstra, A. H. and Nijgh, G. J.: *The ratio of gravitational to kinetic mass for the constituents of matter.* Physica **21,** 796–798 (1955)

Will, C. M.: *Active mass in relativistic gravity: theoretical interpretation of the Kreuzer experiment.* Astrophys. J. **204,** 224–234 (1976)

Will, C. M.: *Theory and Experiment in Gravitational Physics.* Cambridge, U.K., Cambridge University Press (1981)

Wilson, H. A.: *Note on the ratio of mass to weight for bismuth and aluminum.* Phys. Rev. **20,** 75–77 (1922)

7. Measurements of the Dependence of *G* on Temperature

Barton, E. H.: *Gravitation and temperature.* Nature (London) **97,** 461–462 (1916)

Barton, E. H.: *Thermodynamics and gravitation.* Nature (London) **99,** 45 (1917)

Barus, C.: *The displacement of the gravitating needle in its dependence on atmospheric temperatures.* Proc. Nat. Acad. Sci. U.S.A. **5,** 547–550 (1919)

Barus, C.: *Special articles. The interaction of gravitating and radiant forces.* Science **50,** 279–282 (1919)

Brush, C. F.: *Discussion of the kinetic theory of gravitation III: Some experimental evidence supporting theory; continual generation of heat in some igneous rocks and minerals. Relation of this to the internal heat of the earth and presumbly of the sun.* Proc. Am. Philos. Soc. **65,** 207–230 (1926)

Brush, C. F.: *Persistent generation of heat in some rocks and minerals; and its probable significance.* Proc. Am. Philos. Soc. **66,** 251–266 (1927)

Brush, C. F.: *Discussion of the kinetic theory of gravitation IV: Correlation of continual generation of heat in some substances, and impairment of their gravitational acceleration.* Proc. Am. Philos. Soc. **67,** 105–117 (1928)

Brush, C. F.: *Gravitation.* Proc. Am. Philos. Soc. **68,** 55–68 (1929)

Donnan, F. G.: *Heat of reaction and gravitational field.* Nature (London) **104,** 392–393 (1919)

Fitzgerald, G. F.: *Helmholtz memorial lecture.* J. Chem. Soc., Trans. **69,** 885–912 (1896)

Fordyce, G.: *An account of some experiments on the loss of weight in bodies on being melted or heated.* Philos. Trans. R. Soc. London **75,** 361–365 (1785)

Larmor, J.: *Gravitation and temperature.* Nature (London) **97,** 321 (1916)

Larmor, J.: *Gravitation and temperature.* Nature (London) **97,** 421 (1916)

Larmor, J.: *Thermodynamics and gravitation.* Nature (London) **99,** 44–45 (1917)

Lindemann, F. A. and Burton, C. V.: *The temperature coefficient of gravity.* Nature (London) **98,** 349 (1917)

Lodge, O.: *Gravitation and thermodynamics.* Nature (London) **99,** 104 (1917)

Lodge, O.: *Continued discussion of the astronomical and gravitational bearings of the electrical theory of matter.* Philos. Mag. **35,** 141–156 (1918)

Paterson, C. C.: *Discussion.* Chem. News **115,** 116–117 (1917)

Paterson, C. C.: *Discussion.* Proc. Phys. Soc. London **29,** 163–170 (1917)

Pettersson, H.: *A new micro-balance and its use.* Thesis, Göteborg University, Sweden, Vet. of Vitterh. Samhalle's Handlinger, Wald. Zachrissons Boktryckeri A.-B. 91 pp. (1914)

Pettersson, H.: *Experiments with a new micro-balance.* Proc. Phys. Soc. London **32,** 209–211 (1920)

Poynting, J. H. and Phillips, P.: *An experiment with the balance to find if change of temperature has any effect upon weight.* Proc. R. Soc. London, Ser. A **76,** 445–457 (1905)

Shaw, P. E.: *The Newtonian constant of gravitation as affected by temperature.* Philos. Trans. R. Soc. London **216,** 349–392 (1916)

Shaw, P. E.: *Gravitation and temperature.* Nature (London) **97,** 400–401 (1916)

Shaw, P. E. and Sampson, R. A.: *Mathematics and physics at the British Association.* Nature (London) **98,** 120 (1916)

Shaw, P. E.: *Response to Lindemann and Burton.* Nature (London) **98,** 350 (1917)

Shaw, P. E. and Hayes, C.: *Societies and academies, London Physical Society.* Nature (London) **99,** 77 (1917)

Shaw, P. E.: *Gravitation and thermodynamics.* Nature (London) **99,** 84–85 (1917)

Shaw, P. E.: *Gravitation and thermodynamics.* Nature (London) **99,** 165 (1917)

Shaw, P. E. and Hayes, C.: *A special test on the gravitation temperature effect (Physical Society Annual General Meeting notice).* Chem. News **115,** 116–117 (1917)

Shaw, P. E. and Hayes, C.: *A special test on the temperature effect of gravitation.* Proc. Phys. Soc. London **29,** 163–170 (1917)

Shaw, P. E. and Davy, N.: *The effect of temperature on gravitative attraction.* Proc. R. Soc. London **102,** 46–47 (1922)

Shaw, P. E. and Davy, N.: *The effect of temperature on gravitative attraction (meeting notice).* Nature (London) **109,** 462 (1922)

Shaw, P. E. and Davy, N.: *The effect of temperature on gravitative attraction.* Phys. Rev. **21,** 680–691 (1923)

Smith, F. E.: *Discussion.* Chem. News **115,** 116–117 (1917)

Smith, F. E.: *Discussion.* Proc. Phys. Soc. London **29,** 163–170 (1917)

Southerns, L.: *Experimental investigation as to dependence of gravity on temperature.* Proc. R. Soc. London, Ser. A **78,** 392–403 (1906)

Thomas, J. S. G.: *Gravitation and thermodynamics.* Nature (London) **99,** 405 (1917)

Thompson, B. (Count of Rumford): *An inquiry concerning the weight ascribed to heat.* Philos. Trans. R. Soc. London **89,** 179–194 (1799)

Thompson, B.: *An inquiry concerning the weight ascribed to heat.* A Journal of Natural Philosophy, Chemistry and the Arts: Illustrated with Engravings **3,** 381–390 (1799/1800)

Thompson, B.: *An inquiry concerning the weight ascribed to heat.* Bibliothèque Britannique, Genève **13,** 217–238 (1800)

Thompson, B.: *An inquiry concerning the weight ascribed to heat.* In: *Philosophical Papers, Vol. 1,* edited by T. Cadell, Jr. and W. Davies, London 366–383 (1802)

Thompson, B.: *An inquiry concerning the weight ascribed to heat.* In: *The complete Works of Count Rumford, Vol. 2,* Boston, American Academy of Arts and Sciences 1–22 (1873)

Thompson, B.: *An inquiry concerning the weight ascribed to heat.* In: *Collected Works of Count Rumford, Vol. 1,* edited by Sanborn C. Brown, Cambridge, Massachussetts, Belknap Press 27–48 (1968)

Todd, G. W.: *Thermodynamics and gravitation: a suggestion.* Nature (London) **99,** 5–6 (1917)

Todd, G. W.: *Gravitation and thermodynamics.* Nature (London) **99,** 104–105 (1917)

8. Measurements of the Dependence of *G* on the Radioactivity of Masses

Compton, A. H.: *Radioactivity and the gravitational field.* Philos. Mag. **39,** 659–662 (1920)

Freed, S., Jaffey, A. H., Schultz, M. L.: *High centrifugal fields and radioactive decay.* Phys. Rev. **63,** 12–17 (1943)

Geigel, R.: *Über Absorption von Gravitationsenergie durch radioaktive Substanz.* Ann. Phys. (Leipzig) **10,** 429–435 (1903)

Kaufmann, W.: *Bemerkungen zu der Arbeit des H. R. Geigel: „Über die Absorption von Gravitationsenergie durch radioaktive Substanz".* Ann. Phys. (Leipzig) **10,** 894–896 (1903)

Ritenour, R. L.: *An experimental search for gravito-nuclear couplings.* University of Virginia Proposal for Doctoral Research, Department of Nuclear Engineering and Engineering Physics, unpublished, 40 pp (1986)

Rutherford, E. and Compton, A. H.: *Radio-activity and gravitation.* Nature (London) **104,** 412 (1919)

Sagnac, G.: *Une relation possible entre la radioactivité et la gravitation.* J. Phys. (Paris) **5,** 455–462 (1906)

Southerns, L.: *A determination of the ratio of mass to weight for a radioactive substance.* Proc. R. Soc. London **84,** 325–344 (1910)

Thomson, J. J.*: *Ratio of weight to mass for a radioactive substance.* Presidential address of the British Association, Winnipeg, Manitoba, Canada (1909)

Whitaker, D. H.: *The effect of acceleration on the decay rate of* ^{198}Au. A preliminary report. Los Alamos National Laboratory Technical Report No. LA-9388-MS, June 1982, 7 pp

Zeeman, P.: *Some experiments on gravitation. The ratio of mass to weight for crystals and radioactive substances.* Proceedings of the Section of Sciences, Koninklijke Akademie van Wetenschappen te Amsterdam **20,** 542–553 (1918)

9. Measurements of the Dependence of *G* on the Electromagnetic Energy Content of Masses

Bauer, L. A.: *Hunting the magnetic pole.* Van Norden Magazine 55–67 (1907)

Bauer, L. A.: *Results of careful weighings of a magnet in various magnetic fields.* Phys. Rev. **25,** 498–499 (1907)

Bauer, L. A.*: *The apparent alterations of the mass of a magnet as disclosed by weighings in various magnetic fields.* Proc. Philos. Soc. Washington, Oct. 26 (1907)

Bauer, L. A.: *The apparent alterations of the mass of a magnet as disclosed by weighings in various magnetic fields.* Science **26,** 752–754 (1907)

Bauer, L. A.: *Is the earth's action on the magnet only a couple?* Terrestrial Magnetism and Atmospheric Electricity **13,** 25–34 (1908)

Bauer, L. A.: *On the apparent alterations of mass disclosed by weighings of magnets.* Terrestrial Magnetism and Atmospheric Electricity **14,** 72–76 (1909)

Bauer, L. A.: cited in *What is gravitation?* by Paul R. Heyl. Scientific Monthly **47,** 114–123 (1938)

Cremieu, V.: *Recherches expérimentales sur la gravitation.* C. R. Acad. Sci. **168,** 227–230 (1919)

Davisson, C.: *Gravitation and electrical action.* Science **43,** 929 (1916)

Kennard, E. H.: *Electrical action and the gravitation constant.* Science **43,** 928–929 (1916)

Lloyd, M. G.: *Does magnetization alter mass?* Terrestrial Magnetism and Atmospheric Electricity **14,** 67–71 (1909)

Loring, F. H.: *Gravitational attraction.* Chem. News **115,** 181–182 (1917)

Nipher, F. E.: *Matter in its electrically explosive state.* Proc. Am. Philos. Soc. **52,** 283–286 (1913)

Nipher, F. E.: *Gravitation and electrical action.* Science Abstracts **19,** 234 (1916)

Nipher, F. E.: *Disturbances impressed upon the earth's magnetic field.* Trans. Acad. Sci. St. Louis **23,** 153–162 (1916)

Nipher, F. E.: *Gravitation and electrical action.* Trans. Acad. Sci. St. Louis **23,** 163–175 (1916)

Nipher, F. E.: *Gravitation and electrical action.* Science **43,** 472–473 (1916)

Nipher, F. E.: *New evidence of a relation between gravitation and electrical action and of local changes in the electrical potential of the earth.* Trans. Acad. Sci. St. Louis **23,** 383–387 (1920)

Richardson, O. W.: *Note on gravitation.* Philos. Mag. **43,** 138–145 (1922)

Simons, L.: *Appendix to 'A note on gravitation'.* Philos. Mag. **43,** 138–145 (1922)

Treder, H.-J., Woodward, J. F., Yourgrau, W.: *Electrogravitational induction: a re-examination. I. On the relativistic theory of Faraday's gravo-electrical speculations.* Gerlands Beitr. Geophys. **88,** 11–22 (1979)

Walker, C.: *Weighings of magnets.* Terrestrial Magnetism and Atmospheric Electricity **14,** 75–76 (1909)

Woodward, J. F.: *An experimental reexamination of Faradayan electrogravitational induction.* Gen. Relativ. Gravit. **12,** 1055–1069 (1980)

10. Measurements of the Dependence of *G* on Inter-Mass Spacing

Blinnikov, S. I.: *Constraints on the gravitational constant from the observations of white dwarfs.* Astrophys. Space Sci. **59,** 13–17 (1978)

Chan, H. A. and Paik, H. J.: *A true Laplacian detector for null test of the inverse square law of gravitation.* In: *Abstracts of the Ninth Conference on General Relativity and Gravitation, v. 2,* edited by E. Schmutzer, Jena, GDR, Friedrich Schiller University, July 1980, 352

Chan, H. A.: *Null test of the gravitational inverse square law with a superconducting gravity gradiometer.* Ph. D. Thesis, University of Maryland 240 pp (1982)

Chan, H. A., Moody, M. V., Paik, H. J.: *Null test of the gravitational inverse square law.* Phys. Rev. Lett. **24,** 1745–1748 (1982)

Chan, H. A. and Paik, H. J.: *Experimental test of a spacial variation of Newtonian gravitational constant at large distances.* In: *Precision Measurement and Fundamental Constants II,* edited by B. N. Taylor and W. D. Phillips, National Bureau of Standards (U.S.) Special Publication 617, U.S. Government Printing Office 601–606 (1984)

Chen, Y. T. and Speake, C. C.: *A note on the double ring experiment to examine the inverse square law of gravitation.* Preprint, Cavendish Laboratory, Cambridge, England, Cambridge University, unpublished (1981)

Chen, Y. T.: *The gravitational field inside a long hollow cylinder of finite length.* Proc. R. Soc. London, Ser. A **382,** 75–82 (1982)

Chen, Y. T.: *A study of non-Newtonian gravitation.* Ph. D. Thesis, Cambridge University, 77 pp (1982)

Chen, Y. T., Cook, A. H., Metherell, A. J. F.: *An experimental test of the inverse square law of gravitation at range of 0.1 m.* Proc. R. Soc. London, Ser. A **394,** 47–68 (1984)

Cook, A. H.: *The nature of gravitation.* Nature (London) **287,** 189–190 (1980)

Czipott, P. V.: *Experimental test of the gravitational inverse square law between 45 cm and 1 m.* Ph. D. Thesis, University of California at San Diego, 129 pp (1983)

Dahlen, F. A.: *Variation of gravity with depth in the earth.* Phys. Rev. D **25,** 1735–1736 (1982)

Fairbank, W. M. and De Bra, D.: *Development of a sensitive superconducting accelerometer and gravity gradiometer.* Stanford University Technical Report No. AFOSR-TR-85-1126, September 1984, 153 pp

Feinberg, G. and Sucher, J.: *Is there a strong van der Waals force between hadrons?* Phys. Rev. D **20,** 1717–1735 (1979)

Finzi, A.: *On the validity of Newton's law at a long distance.* Mon. Not. R. Astron. Soc. **127,** 21–30 (1963)

Finzi, A.: *Question on the validity of Newton's law at cosmic distances.* Nuovo Cimento **28,** 224–226 (1963)

Finzi, A.: *Test for a possible variation of Newton's constant.* Icarus **9,** 191–196 (1968)

Forward, R. L. and Miller, L. R.: *Generation and detection of dynamic gravitational-gradient fields.* Bull. Am. Phys. Soc. **11,** 445 (1966)

Forward, R. L. and Miller, L. R.: *Generation and detection of dynamic gravitational-gradient fields.* J. Appl. Phys. **38,** 512–518 (1967)

Fujii, Y.: *Dilaton and possible non-Newtonian gravity.* Nature (London) **234,** 5–7 (1971)

Fujii, Y.: *Scale invariance and gravity of hadrons.* Ann. Phys. (New York) **69,** 494–521 (1972)

Fujii, Y.: *Scalar-tensor theory of gravitation and spontaneous breakdown of scale invariance.* Phys. Rev. D **9,** 874–876 (1974)

Fujii, Y.: *Spontaneously broken scale invariance and gravitation.* Gen. Relativ. Gravit. **6,** 29–34 (1975)

Fujii, Y.: *Composition independence of the possible finite-range gravitational force.* Gen. Relativ. Gravit. **13,** 1147–1155 (1981)

Fujimoto, M.-K. and Hirakawa, H.: *Theory of the detection of continuous gravitational radiation.* J. Phys. Soc. Japan **46,** 703–706 (1979)

Gibbons, G. W. and Whiting, B. F.: *Newtonian gravity measurements impose constraints on unification theories.* Nature (London) **291,** 636–638 (1981)

Hall, A.: *A suggestion in the theory of Mercury.* Astron. J. **14**(319), 49–51 (1894)

Hirakawa, H., Hiramatsu, S., Ogawa, Y.: *Damping of Brownian motion by cold load.* Phys. Lett. A **63,** 199–202 (1977)

Hirakawa, H., Tsubono, K., Oide, K.: *Dynamical test of the law of gravitation.* Nature (London) **283,** 184–185 (1980)

Hirakawa, H.: *Experimental examination of the inverse square law of gravitation.* In: *Proc. of the 2nd Marcel Grossmann Meeting on General Relativity,* edited by Remo Ruffini, Amsterdam, North Holland 1005–1011 (1982)

Holding, S. C. and Tuck, G. J.: *A new mine determination of the Newtonian gravitational constant.* Nature (London) **307,** 714–716 (1984)

Holding, S. C., Stacey, F. D., Tuck, G. J.: *Gravity in mines – an investigation of Newton's law.* Phys. Rev. D **33,** 3487–3494 (1986)

Hoskins, J. K.: *Test of the inverse square law of gravity at distances of 5 cm and 1 m.* Ph. D. Thesis, University of California at Irvine, 124 pp (1983)

Hoskins, J. K. and Newman, R.: *Test of the inverse square law of gravity at distances of 5 cm and 1 m.* In: *Abstracts of the 10th International Conference on General Relativity and Gravitation, Vol. 2,* edited by B. Bertotti, F. de Felice and A. Pascolini, Rome, Consiglio Nazionale delle Ricerche 984 (1983)

Hoskins, J. K., Newman, R., Schultz, J., Spero, R. E.: *Tests of the gravitational inverse square law using torsion balances.* In: *Precision Measurements and Fundamental Constants II,* edited by B. N. Taylor and W. D. Phillips, National Bureau of Standards (U.S.) Special Publication 617, U.S. Government Printing Office 591–594 (1984)

Hoskins, J. K., Newman, R., Spero, R. E., Schultz, J.: *Experimental tests of the gravitational inverse-square law for mass separation from 2 to 105 cm.* Phys. Rev. D **32,** 3084–3095 (1985)

Hulett, M. J.: *On the Newtonian gravitational constant.* B.A. Thesis, Wesleyan University 1969, unpublished, 97 pp

Hut, P.: *A constraint on the distance dependence of the gravitational constant.* Phys. Lett. B **99,** 174–178 (1981)

Karagioz, O. V., Tarakanov, Yu. A., Izmaylov, V. P.: *Energy scattering in vacuum torsion systems.* Izv. Acad. Sci. USSR Phys. Solid Earth No. 6, 413–416 (1971) [translation of Izv. Akad. Nauk SSSR, Fiz. Zemli No. 6, 69–78 (1971)]

Karagioz, O. V., Voronkov, V. V., Izmaylov, V. P.: *Effect of swinging on movement of a torsion pendulum.* In: *Determination of Gravity Constant and Measurement of Certain Fine Gravity Effects,* edited by Yu. D. Boulanger and M. U. Sagitov, NASA Technical Translation F-15,722, Accession No. N74-30831, 38–47 (1974)

Karagioz, O. V., Izmaylov, V. P., Agafonov, N. I., Kocheryan, E. G., Tarakanov, Yu. A.: *The determination of the gravitational constant with an evacuated torsion balance.* Izv. Acad. Sci. USSR Phys. Solid Earth No. 5, 351–354 (1976) [translation of Izv. Akad. Nauk SSSR, Fiz. Zemli No. 5, 106–111 (1976)]

Karagioz, O. V., Silin, A. A., Izmaylov, V. P.: *On the question of the gravitational constant and its dependence on the distance between interacting masses.* Izv. Acad. Sci. USSR Phys. Solid Earth No. 1, 66–70 (1981) [translation of Izv. Akad. Nauk SSSR, Fiz. Zemli No. 1, 92–97 (1981)]

Kim, Y. E., Klepacki, D. J., Hinze, W. J.: *The sensitivity of the mass density profile on the geophysical determination of the gravitational constant.* Purdue University preprint No. PNTG-86-12, July 1986, 9 pp

Kimura, S., Suzuki, T., Hirakawa, H.: *Low frequency antenna for gravitational radiation.* Phys. Lett. A **81,** 302–304 (1981)

Kuroda, K., Tsubono, K., Hirakawa, H.: *Suppression of Brownian motion by gravity field.* Phys. Lett. A **92,** 121–122 (1982)

Kuroda, K. and Hirakawa, H.: *Rf-transducer for mechanical vibrations.* Jpn. J. Appl. Phys. **22,** 1005–1008 (1983)

Kuroda, K., Tsubono, K., Hirakawa, H.: *Calibration of vibration transducers.* Jpn. J. Appl. Phys. **23,** L415–L416 (1984)

Kuroda, K. and Hirakawa, H.: *Experimental test of the law of gravitation.* Phys. Rev. D **32,** 342–346 (1985)

Laplace, Marquis de: *Sur la loi de l'attraction universelle.* In: *Oeuvres de Laplace, Vol. 5, Book 16, Chap. 4,* Paris, Imprimerie Royale 477–484 (1845)

Levitt, L. S.: *The gravitational constant at time zero.* Lett. Nuovo Cimento **29,** 23–24 (1980)

Liakhovets, V. D.: *Spatial variations of the gravitational constant.* Izv. Akad. Nauk SSSR, Fiz. Zemli No. 8, 98–99 (1986)

Liu, H., Zhang, P., Qin, R.: *Test of Newtonian inverse square law at laboratory distances.* Academia Sinica preprint, 2 pp (1982)

Liu, H., Zhang, P., Qin, R.: *Test of Newtonian inverse square law at laboratory distances.* Kexue Tongbao **28,** 1328–1330 (1983)

Liu, H., Zhang, P., Qin, R.: *A null experiment of gravitational inverse square law.* In: *Proceedings of the 3rd Marcel Grossmann Meeting on General Relativity,* edited by Hu Ning, Beijing, Science Press 1501–1504 (1983)

Long, D. R.: *Theory for mass and gravitation; calculation of the gravitational constant.* Bull. Am. Phys. Soc. **12,** 1057 (1967)

Long, D. R.: *Predicted gravitational inverse square law anomaly.* Bull. Am. Phys. Soc. **15,** 1640–1641 (1970)

Long, D. R.: *Why do we believe Newtonian gravitation at laboratory dimensions?* Phys. Rev. D **9,** 850–852 (1974)

Long, D. R. and Ogden, D.: *Producing an ultra-high uniformity gravitational field.* Phys. Rev. D **10,** 1677–1680 (1974)

Long, D. R.: *Observation of the mass separation dependence of the gravitational constant.* Bull. Am. Phys. Soc. **20,** 1488 (1975)

Long, D. R.*: *Experimental examination of the gravitational inverse square law at laboratory distances.* Experimental Notes, Cheney, Washington, Eastern Washington University Archives No. 75-19, 4 vol., 1167 pp (1975)

Long, D. R.: *Experimental examination of the gravitational inverse square law.* Nature (London) **260,** 417–418 (1976)

Long, D. R.: *Vacuum polarization and non-Newtonian gravitation.* Nuovo Cimento, B **55,** 252–256 (1980)

Long, D. R.: *Current measurements of the gravitational 'constant' as a function of mass separation.* Nuovo Cimento, B **62,** 130–138 (1981)

Long, D. R.: *Vacuum polarization and recent measurements of the gravitational constant as a function of mass separation.* In: *Precision measurements and Fundamental Constants II,* edited by B. N. Taylor and W. D. Phillips, National Bureau of Standards (U.S.) Special Publication 617, U.S. Government Printing Office 587–590 (1984)

Luther, G. G. and Towler, W. R.: Private communication to R. C. Ritter, cited in: *Experimental searches for gravitational effects outside of general relativity.* In: *Proc. of the 2nd Marcel Grossmann Meeting on General Relativity,* edited by Remo Ruffini, Amsterdam, North Holland 1039–1070 (1982)

Mackenzie, A. S.: *On the attractions of crystalline and isotropic masses at small distances.* Phys. Rev. **2,** 321–343 (1895)

Maddox, J.: *Continuing doubt on gravitation.* Nature (London) **310,** 723 (1984)

Maddox, J.: *Newtonian gravitation corrected.* Nature (London) **319,** 173 (1986)

Mapoles, E. R.: *Development of a superconducting gravity gradiometer for a test of the inverse square law.* Ph. D. Thesis, Stanford University, 120 pp (1981)

McQueen, H. W. S.: *Independence of the gravitational constant from gross earth data.* Phys. Earth Planet. Interiors **26,** P6–P9 (1981)

Mikkelson, D. R. and Newman, M. J.: *Constraints on the gravitational constant at large distances.* Phys. Rev. D **16**, 919–926 (1977)

Mills, Jr., A. P.: *Proposed null experiments to test the inverse square nature of gravitation.* Gen. Relativ. Gravit. **11**, 1–11 (1979)

Milyukov, V. K.: *Experimental verification of the law of gravity for laboratory distances.* Sov. Phys. JETP **61**, 187–191 (1985) [translation of Zh. Eksp. Teor. Fiz. **88**, 321–328 (1985)]

Mio, N., Tsubono, K., Hirakawa, H.: *Measurement of gravitational interaction at small distances.* Jpn. J. Appl. Phys. **23**, 1159–1160 (1984)

Mucket, J. P. and Treder, H.-J.: *The perihelion advance according to a post Newtonian gravitational law with logarithmic correction term.* Astron. Nach. **298**(2), 65–67 (1977)

Newcomb, S.: *Note on accounting for the secular variations of the orbits of Venus and Mercury.* Astron. J. **14**(327), 117–118 (1894)

Newcomb, S.: *Hypothesis that gravitation toward the sun is not exactly as the inverse square of the distance.* In: *The elements of the Four Inner Planets and the Fundamental Constants of Astronomy,* Supplement to the American Ephemeris and Nautical Almanac for 1897, Washington, U.S. Government Printing Office 118–120 (1895)

Newman, R., Pellam, J., Schultz, J., Spero, R. E.: *Experimental test of the gravitational inverse square law at laboratory distances.* In: *Abstracts of the Eighth Conference on General Relativity and Gravitation,* edited by C. B. Collins, Waterloo, Ontario, Canada, Department of Applied Mathematics, University of Waterloo, August 1977, 268

Newman, R., Hoskins, J. K., Pellam, J., Schultz, J., Spero, R. E.: *Test of the gravitational inverse square law.* In: *Abstracts of the Ninth Conference on General Relativity and Gravitation,* edited by E. Schmutzer, Jena, GDR, Friedrich Schiller University, July 1980, 361–362

Newman, R.: *Tests of the gravitational inverse square law on a laboratory distance scale.* In: *Proc. of the 3rd Marcel Grossmann Meeting on General Relativity,* edited by Hu Ning, Beijing, Science Press 755–770 (1983)

Newman, R.: *Experiments with a cryogenic torsion balance.* In: *Proc. of the 3rd Marcel Grossmann Meeting on General Relativity,* edited by Hu Ning, Beijing, Science Press 1497–1500 (1983)

Ni, W.-T.: *Measurement of gravitational forces due to oil tank and swimming pool and the inverse square law.* Physics (Taiwan) **2**, 2–5 (1980)

Nieto, M. M.: *Physics at the proposed national underground science facility.* In: *Proceedings of the 14th International Conference on Multiparticle Dynamics,* in press

Nobili, A. M., Milani, A., Farinella, P.: *Testing newtonian gravity in space.* University of Pisa, preprint, 12 pp (1986)

Oelfke, W. C.: *The measurement of G for small intermass spacings.* In: *Precision Measurements and Fundamental Constants II,* edited by B. N. Taylor and W. D. Phillips, National Bureau of Standards (U.S.) Special Publication 617, U.S. Government Printing Office 607–610 (1984)

Oelfke, W. C.: *The measurement of G for small intermass spacings.* In: *Digest of the 1984 Conference on Precision Electromagnetic Measurements,* Delft, Holland, IEEE Catalog No. 84CH2057-8, 59 (1984)

Ogawa, Y., Tsubono, K., Hirakawa, H.: *Experimental test of the law of gravitation.* Phys. Rev. D **26**, 729–734 (1982)

Ogawa, Y., Tsubono, K., Hirakawa, H.: *Experimental test of the law of gravitation.* In: *Abstracts of the 10th International Conference on General Relativity and Gravitation. Vol. 2,* edited by B. Bertotti, F. de Felice and A. Pascolini, Rome, Consiglio Nazionale delle Ricerche 999–1001 (1983)

O'Hanlon, J.: *Intermediate-range gravity: A generally covariant model.* Phys. Rev. Lett. **29**, 137–138 (1972)

Oide, K., Ogawa, Y., Hirakawa, H.: *Artificial cold resistors.* Jpn. J. Appl. Phys. **17**, 429–432 (1978)

Oide, K., Tsubono, K., Hirakawa, H.: *The gravitational field of a rotating bar.* Jpn. J. Appl. Phys. **19**, L 123–L 125 (1980)

Owa, S., Tsubono, K., Hirakawa, H.: *Characteristics of low frequency cryogenic antennas for gravitational radiation.* Jpn. J. Appl. Phys. **22**, L 452–L 454 (1983)

Paik, H. J.: *Superconducting tunable-diaphragm transducer for sensitive acceleration measurements.* J. Appl. Phys. **47**, 1168–1178 (1976)

Paik, H. J., Mapoles, E. R., Wang, K. Y.: *Superconducting gravity gradiometers.* In: *Future Trends in Superconductive Electronics,* edited by B. S. Deaver, Jr., C. M. Falco, J. H. Harris and S. A. Wolf, AIP Conference Proceedings No. 44, New York, American Institute of Physics 166–170 (1978)

Paik, H. J.: *New null experiment to test the inverse square law of gravitation.* Phys. Rev. D **19**, 2320–2324 (1979)

Paik, H. J. and Chan, H. A.: *Experimental examination of the inverse-square law of gravitation.* In: *Proc. of the 2nd Marcel Grossmann Meeting on General Relativity,* edited by Remo Ruffini, Amsterdam, North Holland 1013–1018 (1982)

Paik, H. J.: *A null test of the inverse square law of gravitation.* In: *Proc. of the 3rd Marcel Grossmann Meeting on General Relativity,* edited by Hu Ning, Beijing, Science Press 839–854 (1983)

Paik, H. J.: *Null test of the inverse square law in the earth's orbit.* In: *Abstracts of the 10th International Conference on General Relativity, Vol. 2,* edited by B. Bertotti, F. De Felice and A. Pascolini, Rome, Consiglio Nazionale delle Ricerche 966 (1983)

Panov, V. I. and Frontov, V. N.: *The Cavendish experiment at large distances.* Sov. Phys. – JETP **50**, 852–856 (1979) [translation of Zh. Eksp. Teor. Fiz. **77**, 1701–1707 (1979)]

Panov, V. I. and Frontov, V. N.: *Experimental test of the space variability hypothesis for the gravitational constant.* In: *Abstracts of the Ninth Conference on General Relativity and Gravitation,* edited by E. Schmutzer, Jena, GDR, Friedrich Schiller University, July 1980, 363–364

Piso, M., Minti, H., Cristea, O., Saru, D., Alexandrescu, M., Lupu, D., Stancu, D., Aciu, A., Popovici, L.: *Short range $1/R^2$ experiments.* In: *Abstracts of the 11th International Conference on General Relativity and Gravitation, Vol. 2,* Stockholm 621 (1968)

Ritter, R. C.: *Experimental searches for gravitational effects outside of general relativity.* In: *Proc. of the 2nd Marcel Grossman Meeting on General Relativity,* edited by Remo Ruffini, Amsterdam, North Holland 1039–1070 (1982)

Riveros, C. and Vucetich, H.: *Bounds on the validity of Newton's gravitational law from electromagnetic solar deflection.* Phys. Rev. D **34,** 321–326 (1986)

Rudenko, V. N.: *Large scale Cavendish experiments.* Moscow Univ. Phys. Bull. No. 5, 80–84 (1979) [translation of Vest. Mosk. Univ., Fiz. No. 5, 83–86 (1979)]

Sagitov, M. U. and Milyukov, V. K.: *The determination of the gravitational constant and its possible spatial and temporal changes.* Fizikai Szemli, (Budapest) **33**(1), 12–24 (1983)

Sanders, R. H.: *Anti-gravity and galaxy rotation curves.* Astron. Astrophys. **136**(2), L21–L23 (1984)

Schwede, H. F.: *Planetary orbits.* Bull. Am. Phys. Soc. **30,** 1137 (1985)

Schwede, H. F.: *Solar orbits and the Newtonian G.* Bull. Am. Phys. Soc. **30,** 1137 (1985)

Seeliger, H.: *Über das Newton'sche Gravitationsgesetz.* Astron. Nachr. **137**(3273), 129–136 (1895)

Seeliger, H.*: *Über das Newton'sche Gesetz.* Sitzungsberichte der Münchener Akademie (1896)

Shey, Y.-C.: *A gravitational field equation with higher order derivatives and its spherically symmetric static solutions.* Acta Physica Sinica **28,** 741–747 (1979)

Simaciu, I.: *Experiments for measuring gravitation constant G and study of molecular screening forces.* In: *Abstracts of the 11th International Conference on General Relativity and Gravitation, Vol. 2,* Stockholm 626 (1986)

Spero, R. E., Hoskins, J. K., Newman, R., Pellam, J., Schultz, J.: *Test of the gravitational inverse square force law at short distances.* Bull. Am. Phys. Soc. **24,** 579 (1979)

Spero, R. E.: *A laboratory test of the inverse square law of gravity.* Ph.D. Thesis, University of California at Irvine, 128 pp (1979)

Spero, R. E., Hoskins, J. K., Newman, R., Pellam, J., Schultz, J.: *Test of the gravitational inverse square law at laboratory distances.* Phys. Rev. Lett. **44,** 1645–1648 (1980)

Stacey, F. D., Tuck, G. J., Holding, S. C., Maher, A. R., Morris, D.: *Constraint on the planetary scale value of the Newtonian gravitational constant from the gravity profile within a mine.* Phys. Rev. D **23,** 1683–1692 (1981)

Stacey, F. D. and Tuck, G. J.: *Geophysical evidence for non-Newtonian gravity.* Nature (London) **292,** 230–232 (1981)

Stacey, F. D.: *Subterranean gravity and other deep hole geophysics.* In: *Science Underground,* edited by M. M. Nieto, W. C. Haxton, C. M. Hoffman, E. W. Kolb, V. D. Sandberg, J. W. Toevs, Am. Inst. Phys. Conf. Proc. No. 96, New York, American Institute of Physics 285–297 (1983)

Stacey, F. D. and Tuck, G. J.: *Non-Newtonian gravity: geophysical evidence.* In: *Precision Measurements and Fundamental Constants II,* edited by B. N. Taylor and W. D. Phillips, National Bureau of Standards (U.S.) Special Publication 617, U.S. Government Printing Office 597–600 (1984)

Stacey, F. D.: *Gravity.* Sci. Prog. (Oxford) **69,** 1–17 (1984)

Stacey, F. D., Tuck, G. J., Holding, S. C., Moore, G. I., Goodwin, B. D., Zhou, R.: *Large scale tests of the inverse square law.* In: *Abstracts of the 11th International Conference on General Relativity and Gravitation, Vol. 2,* Stockholm 627 (1986)

Sugimoto, D.: *Astrophysical test for dilaton theory of non-Newtonian gravity.* Prog. Theor. Phys. **48,** 699–700 (1972)

Suzuki, T. and Hirayama, H.: *Local field and gravitational radiation experiments.* J. Phys. Soc. Jpn. **48,** 685–686 (1980)

Suzuki, T., Tsubono, K., Kuroda, K., Hirakawa, H.: *Calibration of gravitational radiation antenna by dynamic Newton field.* Jpn. J. Appl. Phys. **20,** L498–L500 (1981)

Thiessen, P. A. and Treder, H.-J.: *Gibt es Oberflächeneffekte der Gravitation?* Gerlands Beitr. Geophys. **91,** 97–107 (1982)

Tisserand, F.: *Confrontation de la loi de Newton avec les observations. Hypothèse de M. A. Hall.* In: *Traité de Mécanique Céleste, Vol. 4, Chap. 29,* Paris, Gauthier-Villars 539–542 (1896)

Tohline, J. E.: *Stabilizing a cold disk with a 1/r force law.* In: *Internal Kinematics and Dynamics of Galaxies,* edited by E. Athanassoula, Int. Astron. Union Symp. No. 100, Dordrecht, Reidel 205–206 (1983)

Tsubono, K., Hiramatsu, S., Hirakawa, H.: *Cavity transducer for subatomic mechanical vibration.* Jpn. J. Appl. Phys. **16,** 1641–1645 (1977)

Warburton, R. J., Beaumont, C., Goodkind, J. M.: *The effect of ocean tide loading on tides of the solid earth observed with the superconducting gravimeter.* Geophys. J. R. Astron. Soc. **43,** 707–720 (1975)

Wulf, T.: *Zum Nachweis der Newtonschen allgemeinen Massenanziehung.* Phys. Z. **23,** 154–157 (1922)

Yabushita, S.: *On Finzi's hypothesis about the long range behavior of Newtonian force.* Nuovo Cimento **33,** 769–775 (1964)

Yamaguchi, Y.: *On a test of Fujii's theory of gravitation.* Prog. Theor. Phys. **58,** 723–724 (1977)

Yu, H.-T.: *An experimental determination of the gravitational constant at distances around ten meters.* M.S. Thesis, National Tsing Hua University, Taiwan, 42 pp (1978)

Yu, H.-T., Ni, W.-T., Hu, C.-C., Liu, F.-H., Yang, C.-H., Liu, W.-N.: *An experimental determination of the gravitational constant at distances around ten meters.* Chin. J. Phys. (Taiwan) **16,** 201–213 (1978)

Yu, H.-T., Ni, W.-T., Hu, C.-C., Liu, F.-H., Yang, C.-H., Liu, W.-N.: *Experimental determination of the* *gravitational forces at separations around ten meters.* Phys. Rev. D **20**, 1813–1815 (1979)

Yu, H.-T., Ni, W.-T., Hu, C.-C., Liu, F.-H., Yang, C.-H., Liu, W.-N.: *Measurement of the gravitational forces at separations around 10 meters.* In: *Precision Measurements and Fundamental Constants II,* edited by B. N. Taylor and W. D. Phillips, National Bureau of Standards (U.S.) Special Publication 617, U.S. Government Printing Office 595–596 (1984)

Zaitsev, N. A. and Kolosnitsyn, N. I.: *The dynamical investigation of the Newtonian law of gravitation on test masses.* In: *Abstracts of the 11th International Conference on General Relativity and Gravitation, Vol. 2,* Stockholm 630 (1986)

11. Measurements of the Dependence of *G* on Time

Alpher, R. A. and Gamow, G.: *A possible relation between cosmological quantities and the characteristics of elementary particles.* General Electric Corp. Research Report. No. 68-C-307, Sept 1968, 4 pp.

Alpher, R. A. and Gamow, G.: *A possible relation between cosmological quantities and the characteristics of elementary particles.* Proc. Nat. Acad. Sci.(U.S.) **61**, 363–366 (1968)

Alpher, R. A.: *Large numbers, cosmology, and Gamow.* Am. Sci. **61**, 52–58 (1973)

Alpher, R. A.: *More on varying G.* Phys. Today **34**(3), 12–13 (1981)

Anderson, J. D., Keesey, M. S., Lau, E. L., Standish, E. M., Newhall, X. X.: *Tests of general relativity using astrometric and radiometric observations of the planets.* Astronautica **5**, 43–61 (1978)

Anderson, J. D. and Estabrook, F. B.: *Application on DSN spacecraft tracking technology to experimental gravitation.* J. Spacecraft and Rockets **16**, 120–125 (1979)

Ashby, N., Bender, P. L., Wahr, J. M.: *Accuracy of gravitational physics tests and of the solar quadrupole moment from ranging to a mercury orbiter.* In: *Abstracts of the 10th International Conference on General Relativity and Gravitation, Vol. 2,* edited by B. Bertotti, F. de Felice and A. Pascolini, Rome, Consiglio Nazionale delle Ricerche, 947 (1983)

Barrell, S. S.: *Analysis of the effect on graded beds of changing gravitational acceleration with time – a prototype paleogravimeter.* M. S. Thesis, Univ. of South Carolina, 48 pp. (1976)

Barrow, J. D.: *A cosmological limit on the possible variation of G.* Mon. Not. R. Astron. Soc. **184**, 677–682 (1978)

Barrow, J. D.: *The lore of the large numbers: some historical background to the anthropic principle.* Q. J. R. Astron. Soc. **22**, 388–420 (1981)

Beams, J. W.: *Proposed method of measuring small variations in the gravitational constant G.* Bull. Am. Phys. Soc. **18**, 267 (1973)

Beams, J. W.: *Proposed method for searching for variations in the gravitational constant.* University of Virginia, preprint, 7 pp., unpublished (1975)

Bender, P. L., Dicke, R. H., Wilkinson, D. T., Alley, C. O., Currie, D. G., Faller, J. E., Mulholland, J. D., Silverberg, E. C., Plotkin, H. E., Kaula, W. M., MacDonald, G. J. F.: *The lunar laser ranging experiment.* In: *Proceedings of the Conference on Experimental Tests of Gravitation Theories,* edited by R. W. Davies, JPL Tech. Memo. 33-499, NASA Contractor Report NASA-CR-124710, Pasadena, California, California Institute of Technology, November 1, 178–181 (1971)

Bender, P. L., Ashby, N., Vincent, M. A., Wahr, J. M.: *Mercury relativity satellite.* In: *Abstracts of the Mercury Conference.* Tucson, Arizona (1986)

Birch, F.: *On the possibility of large changes in the earth's volume.* Phys. Earth Planet Interiors **1**, 141–147 (1968)

Bishop, N. T.: *Time-varying gravity and the abundance of helium.* Mon. Not. R. Astron. Soc. **188**, 839–840 (1979)

Blake, G. M.: *The rate of change of G.* Mon. Not. R. Astron. Soc. **178**, 41P–43P (1977)

Blake, G. M.: *Is the earth contracting?* Geophys. J. R. Astron. Soc. **51**, 555–559 (1977)

Blake, G. M.: *The large numbers hypothesis and the rotation of the earth.* Mon. Not. R. Astron. Soc. **185**, 399 (1978)

Bleksley, A. E. H.: *A new approach to cosmology. IV.* S. Afr. J. Sci. **50**, 61–64 (1953)

Blitch, M. G.: *The feasibility of a gravitational clock to test the general theory of relativity.* M. S. Thesis, M.I.T. 161 pp. (1969)

Blood, B. E.: *An elementary analysis of the adaptation of the Beams' experimental concept to a $\Delta G/G$ detector to be used in space.* M.I.T. Measurement Systems Laboratory Report No. RN-60. In: NASA Contractor Report No. CR-115139, Cambridge, Mass., M.I.T. 39 pp. (1970)

Blood, B. E.: *Error study of the Beams' experimental concept used in a $\Delta G/G$ detector.* M.I.T. Measurement Systems Laboratory Report No. RN-63. In: NASA Contractor Report No. CR-115139, Cambridge, Mass., M.I.T. 55 pp. (1971)

Bond, A.: *Variations in the value of G.* New Scientist **33**, 419 (1967)

Braginsky, V. B. and Ginzburg, V. L.: *Possibility of measuring the time dependence of the gravitational constant.* Sov. Phys. Dokl. **19**, 290–291 (1974) [translation of Dokl. Akad. Nauk SSSR **216**, 300–302 (1974)]

Braginsky, V. B., Caves, C. M., Thorne, K. S.: *Laboratory experiments to test post-Newtonian gravity.* Bull. Am. Phys. Soc. **20**, 1488 (1975)

Braginsky, V. B., Caves, C. M., Thorne, K. S.: *Laboratory experiments to test relativitic gravity.* Phys. Rev. D **15**, 2047–2068 (1977)

Braginsky, V. B., Caves, C. M., Thorne, K. S.: *Laboratory experiments to test general relativity.* In: *Gravitazione Sperimentale,* edited by Bruno Bertotti, Atti dei Convegni Lincei, Vol. 34, Rome, Accademia Nazionale dei Lincei 49–72 (1977)

Canuto, V. M. and Lodenquai, J.: *Dirac cosmology.* Astrophys. J. **211**, 342–356 (1977)

Canuto, V. M., Hsieh, S.-H., Owen, J. R.: *Scale covariance and G-varying cosmology. III. The (m, z), (θ_m, z), (θ_i, z), and [N(m), m] tests.* Astrophys. J., Supplement Series **41,** 263 – 300 (1979)

Canuto, V. M. and Owen, J. R.: *Scale covariance and G-varying cosmology. IV. The log N – log S relation.* Astrophys. J., Supplement Series **41,** 301 – 326 (1979)

Canuto, V. M., Hsieh, S.-H., Owen, J. R.: *Varying G.* Mon. Not. R. Astron. Soc. **188,** 829 – 837 (1979)

Canuto, V. M. and Hsieh, S.-H.: *Comment on the paper 'A cosmological limit on the possible variation of G'.* Mon. Not. R. Astron. Soc. **191,** 605 – 606 (1980)

Canuto, V. M. and Hsieh, S.-H.: *Cosmological variation of G and the solar luminosity.* Astrophys. J. **237,** 613 (1980)

Canuto, V. M.: *The earth's radius and the G variation.* Nature (London) **290,** 739 – 744 (1981)

Canuto, V. M. and Goldman, I.: *Atomic and gravitational clocks.* Nature (London) **296,** 709 – 713 (1982)

Canuto, V. M.: *Variable G and the strong equivalence principle.* Int. J. Theor. Phys. **21,** 633 – 663 (1982)

Canuto, V. M., Goldman, I., Shapiro, I. I.: *Testing the strong equivalence principle by radar ranging.* Astrophys. J. **276,** 1 – 3 (1984)

Canuto, V. M. and Goldman, I.: *Astrophysical consequences of a violation of the strong equivalence principle.* Nature (London) **304,** 311 – 315 (1983)

Carey, S. W.*: *Expanding Earth, a Symposium.* University of Sydney, Resources Foundation (1981)

Carr, B. J. and Rees, M. J.: *The anthropic principle and the structure of the physical world.* Nature (London) **278,** 605 – 612 (1979)

Carter, B.: *Large number coincidences and the anthropic principle is cosmology.* In: *Confrontation of Cosmological Theories with Observation,* edited by M. S. Longair, Dordrecht, Reidel, 291 – 298 (1974)

Caves, C. M.: *Theoretical investigations of experimental gravitation.* Ph. D. Thesis, California Institute of Technology, 258 pp. (1979)

Chin, C.-W. and Stothers, R.: *Solar test of Dirac's large numbers hypothesis.* Nature (London) **254,** 206 – 207 (1975)

Chin, C.-W. and Stothers, R.: *Limit on the secular change of the gravitational constant based on studies of solar evolution.* Phys. Rev. Lett. **36,** 833 – 835 (1976)

Chow, T. L.: *The variability of the gravitational constant.* Lett. Nuovo Cimento **31,** 119 – 120 (1981)

Counselman, C. C. and Shapiro, I. I.: *Scientific uses of pulsars.* Science **162,** 352 – 355 (1968)

Curott, D. R. F.: *A pendulum gravimeter for precision detection of scalar gravitational radiation.* Ph. D. Thesis, Princeton University 123 pp. (1965)

Dannehold, T.: *A proposed laboratory experiment to measure $\dot{G}/G$.* Gen. Relativ. Gravit. **14,** 565 – 568 (1982)

Davies, R. D.: *Letters (comment on Wesson's $\dot{G}/G$ article).* Phys. Today **34**(3), 78 (1981)

Dearborn, D. S. and Schramm, D. N.: *Limit on variations of G from clusters of galaxies.* Nature (London) **247,** 441 – 443 (1974)

Desabbata, V. and Rizzati, P.: *A relation between the periodicity of earthquakes and the variation of gravitational constant.* Lett. Nuovo Cimento **20,** 117 – 120 (1977)

Desabbata, V. and Rizzati, P.: *Is there a relation between the speed-ups of some binary pulsars and the variation of gravitational constant?* Lett. Nuovo Cimento **22,** 363 – 366 (1978)

Dicke, R. H.: *Principle of equivalence and the weak interactions.* Rev. Mod. Phys. **29,** 355 – 362 (1957)

Dicke, R. H., Hoffmann, W. F., Krotkov, R.: *Tracking and orbit requirements for experiment to detect variations in gravitational constant.* In: *Space Research II. Proceedings of the 2nd International Space Science Symposium,* edited by H. C. van de Hulst, C. de Jager, A. F. Moore, New York, North Holland 287 – 291 (1961)

Dicke, R. H.: *The secular acceleration of the earth's rotation and cosmology.* In: *The Earth-Moon System,* edited by B. G. Marsden and A. G. W. Cameron, New York, Plenum 98 – 164 (1966)

Dirac, P. A. M.: *Evolutionary cosmology.* Commentarii Pontifica Academia Scientiarum **II**(46), 1 – 16 (1973)

Dirac, P. A. M.*: *The variation of G and the problem of the moon.* Stud. Nat. Sci. **17,** 1 – 7 (1980)

Douglass, Jr., D. H.*: *Two gravity experiments,* presented at the Third Cambridge Conference on Relativity, New York, Goddard Institute for Space Studies, June 8, 1970, unpublished

Eichendorf, W. and Reinhardt, M.: *How constant are fundamental physical quantities?* Z. Naturforsch. Teil A **32,** 532 – 537 (1977)

Ezer, D. and Cameron, A. G. W.: *Solar evolution with varying G.* Can. J. Phys. *44,* 593 – 615 (1966)

Faulkner, D. J.: *Dirac's large numbers hypothesis and the acceleration of the moon's mean longitude.* Mon. Not. R. Astron. Soc. **176,** 621 – 624 (1976)

Finzi, A.: *Test of possible variations of the gravitational constant by the observation of white dwarfs within galactic clusters.* Phys. Rev. **128,** 2012 – 2015 (1962)

Finzi, A.: *On the hypothesis of the variation of the gravitational constant and on some of its consequences.* Ann. Phys. (N.Y.) **26,** 411 – 417 (1964)

Gamow, G.: *Electricity, gravity, and cosmology.* Phys. Rev. Lett. **19,** 759 – 761 (1967)

Gillies, G. T., Ritter, R. C., Lowry, R. A., Beams, J. W.: *An experiment for detecting changes in the universal gravitational constant.* Virginia J. of Sci. **26,** 48 (1975)

Gillies, G. T.: *Development of a drive system yielding highly constant average speed.* M. S. Thesis, University of Virginia 83 pp. (1976)

Gillies, G. T. and Ritter, R. C.: *Experiments on variation of the gravitational constant using precision rotations.* In: *Precision Measurement and Fundamental Cosntants II,* edited by B. N. Taylor and W. D. Phillips, National Bureau of Standards Special Publication 617, U.S. Government Printing Office 629 – 634 (1984)

Groten, E. and Thyssen-Bornemisza, S.: *Approaches in $\Delta G/G$ determination.* Pure Appl. Geophys. **99,** 5–11 (1972)

Groten, E. and Thyssen-Bornemisza, S.: *Time varying gravitational satellite.* Geophys. J. R. Astron. Soc. **29,** 237–239 (1972)

Halpern, L. and Long, C.: *Two methods for measuring the variation of the gravitational parameter, G, using superconducting technology.* In: *On the Measurement of Cosmological Variations of the Gravitational Constant,* edited by L. Halpern, Gainesville, Florida, University Presses of Florida 87–89 (1978)

Hellings, R. W., Adams, P. J., Anderson, J. D., Keesey, M. S., Lau, E. L., Standish, E. M., Canuto, V. M., Goldman, I.: *Experimental test of the variability of G using Viking lander ranging data.* Phys. Rev. Lett. **51,** 1609–1612 (1983)

Hellings, R. W., Anderson, J. D., Keesey, M. S., Lau, E. K., Newhall, X. X., Standish, E. M., Williams, J. G.: *Results from the Viking relativity experiments.* Phys. Rev. Abstr. **16**(5), 33 (1985)

Hoffmann, W. F., Krotkov, R., Dicke, R. H.: *Precision optical tracking of artificial satellites.* IRE Trans. Mil. Electron., MIL-4, 28–37 (1960)

Hoffmann, W. F.: *A pendulum gravimeter for measurement of periodic annual variations in the gravitational constant.* Ph. D. Thesis, Princeton University 122 pp. (1962)

Hoffmann, W. F.: *22-cps pendulum gravimeter for monitoring the gravitational constant as a function of time.* Bull. Am. Phys. Soc. **8,** 29 (1963)

Hovorka, J.*: M.I.T. Letter MSL-127-69 to NASA-MSC, September 15, 1969

Hovorka, J.*: *A force measurement in orbit to check scalar gravitational theory.* M.I.T. Measurement Systems Laboratory Report No. RN-57, Cambridge, Mass., M.I.T. (1969)

Kropotkin, P. N.: *Seasonal periodicity of earthquakes and Mach's principle.* Gerlands Beitr. Geophys. (Leipzig) **84,** 15–19 (1975)

Lambeck, K.: *The history of the earth's rotation.* In: *The Earth: Its Origin, Structure and Evolution,* edited by M. W. McElhinny, Academic Press, New York 59–81 (1979)

Lapiedra, R. and Palacios, J. A.: *Time-varying Newtonian gravity: an upper limit for the rate of change of the gravitational constant.* Astron. Astrophys. **98,** 382–383 (1981)

Lauterbach, R.: *Die Hypothesen der Erdexpansion im Lichte palaogeophysikalischer Ergebnisse.* Ann. Phys. (Leipzig) **42,** 489–495 (1985)

Lee, W. N.*: *A space experiment to determine the constancy of the gravitational constant G.* In: *Review of NASA-sponsored Research at the Measurement Systems Laboratory,* Measurement Systems Laboratory Report PR-7, Cambridge, Mass., M.I.T. (1970)

Lee, W. N.: *A preliminary analysis of the effects of using non-spherical masses in a Beams-type measurement of G or $\Delta G/G$.* M.I.T. Measurement Systems Laboratory Report No. RE-74. In: NASA Contractor Report No. CR-115139, Cambridge, Mass., M.I.T. 44 pp. (1970)

Lewis, B. M.: *Variable G: a solution to the missing mass problem.* Nature (London) **261,** 302–304 (1976)

Lyttleton, R. A. and Fitch, J. P.: *Cosmological change of G and the structure of the earth.* Mon. Not. R. Astron. Soc. **180,** 471–477 (1977)

Lyttleton, R. A. and Fitch, J. P.: *Effect of a changing G on the moment of inertia of the earth.* Astrophys. J. **221,** 412–413 (1978)

Malamud, H.: *Letters (comment on Wesson's $\dot{G}/G$ article).* Phys. Today **34**(3), 78 (1981)

Mansfield, V. N.: *Pulsar spin down and cosmologies with varying gravity.* Nature (London) **261,** 560–562 (1976)

Marchant, A. and Mansfield, V. N.: *Evolution of dynamical systems with time-varying gravity.* Nature (London) **270,** 699–700 (1977)

McElhinny, M. W., Taylor, S. R., Stevenson, D. J.: *Limits to the expansion of Earth, Moon, Mars, and Mercury and to changes in the gravitational constant.* Nature (London) **271,** 316–321 (1978)

Mel'nikov, V. N. and Radynov, A. G.: *Cosmological expansion and measurements of physical quantities.* Measurement Techniques No. 4, 290–296 (1985) [translation of Izmeritel'naya Tekhnika No. 4, 10–13 (1985)]

Morganstern, R. E.: *Cosmological upper limit on the time variation of G.* Nature (London) **232,** 109–110 (1971)

Morganstern, R. E.: *Time variation of gravity constant.* Nature (London) **237,** 198 (1972)

Morganstern, R. E.: *Curved space cosmological bounds on the time variation of G.* Nature Phys. Sci. (London) **237,** 70–71 (1972)

Morrison, L. V.: *Rotation of the earth from AD 1663–1972 and the constancy of G.* Nature (London) **241,** 519–520 (1973)

Mulholland, J. D.: *Scientific achievements from ten years of lunar laser ranging.* Rev. Geophys. Space Phys. **18,** 549–564 (1980)

Mulholland, J. D.: *The impact of lunar laser ranging on gravitational theory.* University of Florida Space Astronomy Laboratory preprint, 8 pp. (1985)

Muller, P. H.: *Determination of the cosmological rate of change of G and the tidal acceleration of the earth and moon from ancient and modern astronomical data.* In: *On the Measurement of Cosmological Variations of the Gravitational Constant,* edited by L. Halpern, Gainesville, Florida, University Presses of Florida 91–116 (1978)

Narlikar, J. V. and Rana, N. C.: *Cosmic microwave background spectrum and G-varying cosmology.* Phys. Lett. A **77,** 219–220 (1980)

Narlikar, J. V.: *Cosmologies with variable gravitational constant.* Found. Phys. **13,** 311–323 (1983)

Newton, R. R.: *Experimental evidence for a secular decrease in the gravitational constant G.* J. Geophys. Res. **73,** 3765–3771 (1968)

Nieto, M. M.: *Physics at the proposed national underground science facility.* In: *Proceedings of the 14th International Conference on Multiparticle Dynamics,* in press

Peebles, P. J. and Dicke, R. H.: *Cosmology and the radioactive decay ages of terrestrial rocks and meteorites.* Phys. Rev. **128,** 2006–2011 (1962)

Pinotsis, A. D.: *Variation of the gravitational constant, G, and the age of the sun in the Brans-Dicke cosmology.* Bull. Astron. Inst. Czech. **35,** 220–223 (1984)

Pochoda, P. and Schwarzschild, M.: *Variation of the gravitational constant and the evolution of the sun.* Astrophys. J. **139,** 587–593 (1964)

Reasonberg, R. D., Shapiro, I. I., Pettengill, G. H., Campbell, D. B.: *Bounds on the secular variation of the gravitational constant.* Bull. Am. Astron. Soc. **8,** 308 (1976)

Reasonberg, R. D. and Shapiro, I. I.: *Bound on the secular variation of the gravitational interaction.* In: *Atomic Masses and Fundamental Constants, v. 5,* edited by J. H. Sanders and A. H. Wapstra, New York, Plenum 643–648 (1976)

Reasonberg, R. D. and Shapiro, I. I.: *Solar system tests of general relativity.* In: *Gravitazione Sperimentale,* edited by Bruno Bertotti, Atti dei Convegni Lincei, Vol. 34, Rome, Accademia Nazionale dei Lincei 143–160 (1977)

Reasonberg, R. D. and Shapiro, I. I.: *A radar test of the constancy of the gravitational interaction.* In: *On the Measurement of Cosmological Variations of the Gravitational Constant,* edited by L. Halpern, Gainesville, Florida, University Presses of Florida 71–86 (1978)

Reasonberg, R. D.: *Solar system tests of relativity.* In: *Proceedings of the 3rd Marcel Grossmann Meeting on General Relativity,* edited by Hu Ning, Beijing, Science Press 781–796 (1983)

Reasonberg, R. D.: *The constancy of G and other gravitational experiments.* Philos. Trans. R. Soc. London, Sec. A **310,** 227–238 (1983)

Ritter, R. C., Beams, J. W., Lowry, R. A.: *A laboratory experiment to measure the time variation of Newton's gravitational constant.* In: *Atomic Masses and Fundamental Constants, v. 5,* edited by J. H. Sanders and A. H. Wapstra, New York, Plenum 629–635 (1976)

Ritter, R. C. and Goldstein, Jr., S. J.: *A possible limit on $\dot{G}$ from the periods of Io.* Bull. Am. Phys. Soc. **23,** 544 (1978)

Ritter, R. C. and Beams, J. W.: *A laboratory measurement of the constancy of G.* In: *On the Measurement of Cosmological Variations of the Gravitational Constant,* edited by L. Halpern, Gainesville, Florida, University Presses of Florida 29–70 (1978)

Ritter, R. C.: *Experimental searches for gravitational effects outside of general relativity.* In: *Proc. of the 2nd Marcel Grossmann Meeting on General Relativity,* edited by Remo Ruffini, Amsterdam, North Holland 1039–1070 (1982)

Ritter, R. C. and Gillies, G. T.: *Is $(dG/dt)/G$ a closed issue?* Bull. Am. Phys. Soc. **31,** 805 (1986)

Robinson, A. L.: *New test of variable gravitational constant.* Science **222,** 1316–1317 (1983)

Roeder, R. C. and Demarque, P. R.: *Solar evolution and Brans-Dicke cosmology.* Astrophys. J. **144,** 1016–1023 (1966)

Rothman, T. and Matzner, R.: *Scale-covariant gravitation and primordial nucleosynthesis.* Astrophys. J. **257,** 450–455 (1982)

Roxburgh, I. W.: *Testing relativity and gravitational theories by radar ranging to a heliocentric satellite.* Philos. Trans. R. Soc. London, Ser. A **284,** 589–593 (1977)

Runcorn, S. K.: *Geophysical tests of the earth's expansion hypothesis.* In: *Expanding Earth, a Symposium,* edited by S. W. Carey, Sydney, University of Sydney, Resources Foundation 327 (1981)

Sagitov, M. U. and Milyukov, V. K.: *The determination of the gravitational constant and its possible spatial and temporal changes.* Fizikai Szemli, (Budapest) **33,** 12–24 (1983)

Shapiro, I. I., Smith, W. B., Ash, M. B., Ingalls, R. P., Pettengill, G. H.: *Gravitational constant: experimental bound on its time variation.* Phys. Rev. Lett. **26,** 27–30 (1971)

Shapiro, I. I.: *Testing general relativity: progress, problems, and prospects.* In: *Proceedings of the Conference on Experimental Tests of Gravitation Theories,* edited by R. W. Davies, NASA Contractor Report NASA-CR-124710, Pasadena, California, California Institute of Technology, November 1, 136–147 (1971)

Shapiro, I. I.: *Experimental challenges posed by the general theory of relativity.* In: *Some Strangeness in the Proportion: A Centennial Symposium to Celebrate the Achievements of Albert Einstein, Chapter 8,* edited by Harry Woolf, Reading, Mass., Addison-Wesley, 115–136 (1980)

Shaviv, G. and Bahcall, J. N.*: Publ. Astron. Soc. Pacific **79,** 438 (1967)

Shaviv, G. and Bahcall, J. N.: *Brans-Dicke cosmology and the solar neutrino flux.* Astrophys. J. **155,** 438–439 (1969)

Shaviv, G. and Bahcall, J. N.: *The effect of the Brans-Dicke cosmology on solar evolution and neutrino fluxes.* Astrophys. J. **155,** 135–143 (1969)

Shipman, H. L.: *Letters (comment on Wesson's $\dot{G}/G$ article).* Phys. Today **34**(3), 15 (1981)

Stacey, F. D. and Loper, D. E.: *Thermal histories of the core and mantle.* Phys. Earth Planet. Interiors **36,** 99–115 (1984)

Stephenson, L. M.: *A possible annual variation of the gravitational constant.* Proc. Phys. Soc. London **90,** 601–604 (1967)

Stephenson, L. M.: *Gravitation: constant or variable.* New Scientist **33,** 265–267 (1967)

Stephenson, L. M.: *A dynamical model for gravitation.* Found. Phys. **6,** 143–155 (1976)

Stewart, A. D.: *Is gravity weakening?* Spectrum, No. 74, 16, June 1970

Stothers, R.: *White dwarfs, the galaxy and Dirac's cosmology.* Nature (London) **262,** 477–479 (1976)

Stout, P. R. and Brownell, J. R.*: *Principles of soil physics applied to the reassessment of the universal constant of gravitation.* Preprint, University of California at Davis, unpublished (1974)

Teller, E.: *On the change of physical constants.* Phys. Rev. **73,** 801–802 (1948)

Thorne, K. S., Caves, C. M., Braginsky, V. B.: *Proposal for a new experiment to test general relativity.* Bull. Am. Phys. Soc. **20,** 98 (1975)

Thyssen-Bornemisza, S. and Groten, E.: *New approaches in dG/G determination.* Trans. Am. Geophys. Union **52,** 820 (1971)

Thyssen-Bornemisza, S.: *Eötvös ratio and equivalence principle distorted by time-varying G.* Trans. Am. Geophys. Union **55**(12), 1104 (1974)

Treder, H.-J.: *Kosmische Einflüsse auf die Geologischen Zeitabläufe.* Zeitschrift für Geologische Wissenschaften **7,** 11 – 18 (1979)

Ulrich, R. K.: *Solar models with low neutrino fluxes.* Astrophys. J. **188,** 369 – 378 (1974)

Van Flandern, T. C.: *A new measurement of the rate of change of G.* Bull. Am. Phys. Soc. **20,** 543 (1975)

Van Flandern, T. C.: *A determination of the rate of change of G.* Mon. Not. R. Astron. Soc. **170,** 333 – 342 (1975)

Van Flandern, T. C.: *Recent evidence for variations in the value of G.* Ann. N.Y. Acad. Sci. **262,** 494 – 495 (1975)

Van Flandern, T. C.: *Is gravity getting weaker?* Sci. Am. **234,** 44 – 52 (1976)

Van Flandern, T. C.: *Status of the occultation determination of G-dot.* In: *On the Measurement of Cosmological Variations of the Gravitational Constant,* edited by L. Halpern, Gainesville, Florida, University Presses of Florida 21 – 28 (1978)

Van Flandern, T. C.: *Is the gravitational constant changing?* Astrophys. J. **248,** 813 – 816 (1981)

Van Flandern, T. C.: *Is the gravitational constant changing?* In: *Precision Measurement and Fundamental Constants II,* edited by B. N. Taylor and W. D. Phillips. National Bureau of Standards (U.S.) Special Publication 617, U.S. Government Printing Office 625 – 628 (1984)

Vincent, M. A. and Bender, P. L.: *Mercury relativity satellite.* In: *Abstracts of the 11th International Conference on General Relativity and Gravitation, Vol. 1,* Stockholm 143 (1986)

Vinti, J. P.: *Classical solution of the two-body problem if the gravitational constant diminished inversely with the age of the universe.* Mon. Not. R. Astron. Soc. **169,** 417 (1974)

Wagner, A. R.: *Letters (comment on Wesson's $\dot{G}/G$ article).* Phys. Today **34**(3), 13 – 15 (1981)

Wahlquist, H. D., Anderson, J. D., Estabrook, F. B., Thorne, K. S.: *Recent JPL work on gravity wave detection and solar system relativity experiments. Part B.* In: *Gravitazione Sperimentale,* edited by Bruno Bertotti, Atti dei Convegni Lincei, Vol. 34, Rome, Accademia Nazionale dei Lincei 343 – 350 (1977)

Weiss, R. and Block, B.: *A gravimeter to monitor the $_0S_0$ dilational mode of the earth.* J. Geophys. Res. **70,** 5615 – 5627 (1965)

Weiss, R.: *Gravitation Research.* Quarterly Progress Report of the Research Laboratory of Electronics (M.I.T.) **77,** 59 – 63 (1965)

Wesson, P. S.: *The implications for geophysics of modern cosmologies in which G is variable.* Q. J. R. Astron. Soc. **14,** 9 – 64 (1973)

Wesson, P. S.: *Cosmology and Geophysics.* Bristol, U.K., A. Hilger (1978)

Wesson, P. S.: *Does gravity change with time?* Phys. Today **33**(7), 32 – 37 (1980)

Wesson, P. S.: *Gravity, Particles, and Astrophysics.* Dordrecht, Holland, D. Reidel Publishing Co. (1980)

Wesson, P. S.: *The author comments (on Alpher's letter).* Phys. Today **34**(3), 13 (1981)

Wesson, P. S.: *The author comments (on Wagner's letter).* Phys. Today **34**(3), 15 (1981)

Wesson, P. S.: *The author comments (on the letters of Shipman and Davies).* Phys. Today **34**(3), 78 (1981)

Wesson, P. S.: *The author comments (on Malamud's letter).* Phys. Today **34**(3), 78 (1981)

Wesson, P. S. and Goodson, R. E.: *New pathways in gravitational research (or where is variable-G cosmology going?).* The Observatory **101,** 105 – 108 (1981)

Wilk, L. S.*: *A gravitational experiment in space.* M.I.T. Preprint, unpublished (1969)

Wilk, L. S. (editor): *Studies of space experiments to measure gravitational constant variations and the Eötvös ratio.* M.I.T. Measurement Systems Laboratory Progress Report No. PR-8 on progress to April 1, 1971 on NASA contract NA59-8328, NASA Contractor Report CR-115139, Accession code number N71-35444, 306 pp. (1971)

Williams, J. G., Sinclair, W. S., Yoder, C. F.: *Tidal acceleration of the moon.* Geophys. Res. Lett. **5,** 943 – 946 (1978)

Wu, Y.-S. and Wang, Z.: *Time variation of Newton's gravitational constant in superstring theories.* Phys. Rev. Lett. **57,** 1978 – 1981 (1986)

Yang, J., Schramm, D. N., Steigman, G, Rood, R. T.: *Constraints on cosmology and neutrino physics from big bang nucleosynthesis.* Astrophys. J. **227,** 697 – 704 (1979)

12. Measurements of Spontaneous Matter Creation

Bekenstein, J. D.: *Astronomical consequences and tests of relativistic theories of variable rest masses.* Comments on Astrophysics **8,** 89 – 98 (1979)

Bernard, B. E.: *A hybrid double magnetic suspension.* M. S. Thesis, University of Virginia 73 pp (1982)

Bernard, B. E., Cheung, W. S., Ritter, R. C.: *Frequency-modulated coil sensor for magnetic suspensions.* Rev. Sci. Instrum. **53,** 1743 – 1745 (1982)

Bernard, B. E., Cheung, W. S., Ritter, R. C.: *Properties of a double magnetic suspension.* In: *Proceedings of the 1983 International School and Symposium on Precision Measurement and Gravity Experiment,* edited by W.-T. Ni, Hsinchu, Taiwan, National Tsing Hua University 103 – 118 (1983)

Bernard, B. E., Winkler, L. I., Ritter, R. C.: *Thermal noise in precision rotors.* Metrologia **21,** 115 – 126 (1985)

Bernard, B. E.: *An inertial clock for precision measurements.* Ph. D. Thesis, University of Virginia 183 pp (1985)

Bernard, B. E.: *An inertial clock for precision measurements.* Hadronic Journal Supplement, in press

Bernard, B. E., Ritter, R. C., Gillies, G. T.: *Electronically cooled, corotation inertial clock.* IEEE Trans. Instrum. Meas., submitted for publication

Braginsky, V. B., Panov, V. I., Frontov, V. N.: *Precision balance with radio-engineering displacement-sensing.* Instruments and Experimental Techniques No. 3, 871 – 873 (1977) [translation of Pribory i Tekhnika Eksperimenta No. 3, 225 – 227 (1977)]

Carignan, C., Beaudet, G., Sirois, A.: *Dirac's cosmology: solar models to test two hypotheses of matter creation.* Astron. Astrophys. **75,** 291 – 296 (1979)

Canuto, V. M., Adams, P. J., Tsiang, E.: *Crystal structure and Dirac's Large Numbers hypothesis.* Nature (London) **261,** 438 (1976)

Canuto, V. M., Adams, P. J., Hsieh, S.-H., Tsiang, E.: *Particle creation and Dirac's Large Numbers hypothesis.* Nature (London) **264,** 485 (1976)

Canuto, V. M. and Lodenquai, J.: *Dirac cosmology.* Astrophys. J. **211,** 342 – 356 (1977)

Cheung, W. S., Gillies, G. T., Leyh, C. H., Ritter, R. C.: *Ultra-stable magnetic suspensions for rotors in gravity experiments.* Prec. Engng. **2,** 183 – 186 (1980)

Cheung, W. S.: *Servo driven corotation: development of an inertial clock.* Ph. D. Thesis, University of Virginia 300 pp (1982)

Cheung, W. S., Leyh, C. H., Ritter, R. C.: *Analysis of vertical magnetic suspensions.* In: *Proceedings of the 1983 International School and Symposium on Precision Measurement and Gravity Experiment,* edited by W.-T. Ni, Hsinchu, Taiwan, National Tsing Hua University 81 – 102 (1983)

Cheung, W. S. and Ritter, R. C.: *An inertial clock to test the non-metricity of gravity.* In: *Precision Measurement and Fundamental Constants II,* edited by B. N. Taylor and W. D. Phillips, National Bureau of Standards (U.S.) Special Publication 617, U.S. Government Printing Office 653 – 657 (1984)

Chin, C.-W. and Stothers, R.: *Solar test of Dirac's large numbers hypothesis.* Nature (London) **254,** 206 – 207 (1975)

Cohen, S. A.: *An experimental test of continuous creation.* B. S. Thesis, M.I.T. 23 pp (1968)

Cohen, S. A. and King, J. G.: *Search for continuously created hydrogen.* M.I.T. Research Laboratory of Electronics Quarterly Report **90,** 1 – 6 (1968)

Cohen, S. A. and King, J. G.: *Search for hydrogen appearing in mercury metal.* Nature (London) **222,** 1158 – 1159 (1969)

Dannehold, T.: *An observational test of cosmological particle production theories.* Phys. Lett. B **94,** 450 – 452 (1980)

Dannehold, T.: *The Bogoliubov transformation and its application to cosmological particle production.* Ph. D. Thesis, Washington University 80 pp (1981)

Egyed, L.: *The expanding earth?* Nature (London) **197,** 1059 – 1060 (1963)

Gillies, G. T., Ritter, R. C., Rood, R. T.: *A new standard in turntable speed constancy.* Audio **62,** 78 – 84 (1978)

Gillies, G. T. and Ritter, R. C.: *Recent progress on the dynamic measurement of matter creation.* Bull. Am. Phys. Soc. **25,** 38 – 39 (1980)

Gillies, G. T. and Ritter, R. C.: *Spindown measurements on a protected rotor.* Bull. Am. Phys. Soc. **25,** 491 (1980)

Gillies, G. T.: *The development of high Q, precision mechanical rotors for use in a dynamic measurement of matter creation.* Ph. D. Thesis, University of Virginia 141 pp (1980)

Gillies, G. T. and Ritter, R. C.: *Experiments on variation of the gravitational constant using precision rotations.* In: *Precision Measurement and Fundamental Constants II,* edited by B. N. Taylor and W. D. Phillips, National Bureau of Standards (U.S.) Special Publication 617, U.S. Government Printing Office 629 – 634 (1984)

Gillies, G. T.: *The development of high Q, precision mechanical rotors for use in a dynamic measurement of matter creation.* Hadronic Journal Supplement **2,** 1 – 141 (1986)

Gittus, J. H.: *Dirac's Large Numbers theory and the structure of rocks.* Proc. R. Soc. London, Ser. A **343,** 155 – 158 (1975)

Gittus, J. H.: *Dirac's Large Numbers theory and a theoretical upper limit to the viscosity of crystalline materials.* Proc. R. Soc. London, Ser. A **348,** 95 – 99 (1976)

Gittus, J. H.: *Multiplicative creation in two-phase materials: boundary diffusion and deposition.* United Kingdom Atomic Energy Authority Preprint, unpublished (1978)

Jones, Jr., G. R., Gilles, G. T., Ritter, R. C.: *Measurements of a magnetically suspended precision rotor.* Bull. Am. Phys. Soc. **25,** 491 (1980)

Jones, Jr., G. R.: *Decay time studies of magnetically suspended rotors.* M. S. Thesis, University of Virginia, 111 pp (1981)

Jones, Jr., G. R., Gilles, G. T., Ritter, R. C.: *Decay modes of magnetically suspended precision rotors.* Prec. Engng. **4,** 79 – 83 (1982)

Jones, Jr., G. R., Ritter, R. C., Gillies, G. T.: *Fundamental measurements in gravitational physics using precision rotations. I. Motivations and unprotected rotor results.* Metrologia **18,** 209 – 219 (1982)

Jones, Jr., G. R. and Ritter, R. C.: *Period fluctuation studies of a free magnetically suspended rotor.* Bull. Am. Phys. Soc. **27,** 538 (1982)

Jones, Jr., G. R.: *Development of precision rotor experiment for matter creation test.* Ph. D. Thesis, University of Virginia, 220 pp (1983)

Leyh, C. H.: *A brief history of the precision measurement group at the University of Virginia.* In: *Proceedings of the 1983 International school and Symposium on Precision Measurement and Gravity Experiment,* edited by W.-T. Ni, Hsinchu, Taiwan, National Tsing Hua University 255 – 276 (1983)

Leyh, C. H., Cheung, W. S., Bernard, B. E., Ritter, R. C.: *A rotational inertial clock for gravitational redshift comparisons.* In: *Proceedings of the 1983 International School and Symposium on Precision*

Measurement and Gravity Experiment, edited by W.-T. Ni, Hsinchu, Taiwan, National Tsing Hua University 593–608 (1983)

Leyh, C. H.: *An improved servo-controlled inertial clock for laboratory tests of general relativity.* Ph. D. Thesis, University of Virginia, 365 pp (1984)

MacDougall, J., Butler, R., Kronberg, P., Sandquist, A: *A comparison of terrestrial and universal expansion.* Nature (London) **199,** 1080 (1963)

Malin, S.: *Gravitational field equations and the possibility of time variation of all masses.* Phys. Rev. D **11,** 707–710 (1975)

Mansfield, V. N. and Malin, S.: *Some astrophysical effects of the time variation of all masses.* Astrophys. J. **209,** 335–349 (1976)

Panov, V. I. and Frontov, V. N.: *Electromechanical vibrating system for the observation of small periodic mass variations.* Instrum. Exp. Tech. (USSR) **22,** 217–220 (1979) [translation of Prib. Tekh. Eksp. No. 1, 204–207 (1979)]

Philberth, K.: *The generation of matter and the conservation of energy.* In: *Cosmology, History, and Theology, Chapter 9,* edited by Wolfgang Yourgrau and Allen D. Breck, New York, Plenum 113–129c (1977)

Ritter, R. C., Gillies, G. T., Rood, R. T., Beams, J. W.: *Dynamic measurement of matter creation.* Nature (London) **271,** 228–229 (1978)

Ritter, R. C.: *Macroscopic rotors and gravitational effects.* J. Phys. (Paris) **42,** Colloque C 8, Supplement No. 12, C 8-429–C 8-440 (1981)

Ritter, R. C.: *Experimental searches for gravitational effects outside of general relativity.* In: *Proc. of the 2nd Marcel Grossmann Meeting on General Relativity,* edited by Remo Ruffini, Amsterdam, North Holland 1039–1070 (1982)

Ritter, R. C. and Jones, Jr., G. R.: *Progress in precision rotations for matter creation experiment and inertial clock.* In: *Proceedings of the 3rd Marcel Grossmann Meeting on General Relativity,* edited by Hu Ning, Beijing, Science Press 1485–1489 (1983)

Ritter, R. C. and Cheung, W. S.: *Macroscopic rotors.* In: *Proceedings of the 1983 International School and Symposium on Precision Measurement and Gravity Experiment,* edited by W.-T. Ni, Hsinchu, Taiwan, National Tsing Hua University 445–464 (1983)

Ritter, R. C. and Jones, Jr., G. R.: *Gravitation experiments at the University of Virginia.* In: *Proceedings of the 1983 International School and Symposium on Precision Measurement and Gravity Experiment,* edited by W.-T. Ni, Hsinchu, Taiwan, National Tsing Hua University 571–592 (1983)

Ritter, R. C. and Gillies, G. T.: *Classical limit of mechanical thermal noise reduction by feedback.* Phys. Rev. A **31,** 995–1000 (1985)

Roxburgh, I. W.: *Dirac's continuous creation cosmology and the temperature of the earth.* Nature (London) **261,** 301–302 (1976)

Roxburgh, I. W.: *Large number hypothesis and continuous creation cosmologies.* Nature (London) **268,** 504–507 (1977)

Steigman, G.: *Particle creation and Dirac's large numbers hypothesis.* Nature (London) **261,** 479–480 (1976)

Steigman, G.: *Steigman replies.* Nature (London) **264,** 485 (1976)

Thyssen-Bornemisza, S. and Groten, E.: *Testing inertial mass variations.* Trans. Am. Geophys. Union **53**(4), 345 (1972)

Thyssen-Bornemisza, S. and Groten, E.: *Testing inertial mass variations.* Trans. N.Y. Acad. Sci. **34,** 687–690 (1972)

Towe, K. M.: *Crystal structures, the earth and Dirac's Large Numbers hypothesis.* Nature (London) **257,** 115–116 (1975)

Towe, K. M.: *Towe replies.* Nature (London) **261,** 438 (1976)

Wesson, P. S.: *The implications for geophysics of modern cosmologies in which G is variable.* Q. J. R. Astron. Soc. **14,** 9–64 (1973)

Wesson, P. S.: *Cosmology and Geophysics,* Bristol, U.K., A. Hilger (1978)

Wesson, P. S.: *Dynamic measurement of matter creation and earth expansion.* Nature (London) **273,** 572 (1978)

Wesson, P. S.: *Gravity, Particles, and Astrophysics,* Dordrecht, Holland, D. Reidel Publishing Co. (1980)

Winkler, L. I.: *Precision torsion balance for the study of small electrostatic torques.* Bull. Am. Phys. Soc. **31,** 805 (1986)

Winkler, L. I.: *Measurement of small electrostatic forces using a torsion balance and capacitive position transducer.* Rev. Sci. Instrum. **57,** 3019–3023 (1986)

13. Measurements of the Dependence of *G* on the State of Quantization of the Test Masses

Anandan, J.: *New relativistic gravitational effects using charged-particle interferometry.* Gen. Rel. Gravit. **16,** 33–41 (1984)

Anandan, J.: *Effect of Newtonian gravitational potential on a superfluid Josephson interferometer.* Phys. Rev. B **30,** 3717–3721 (1984)

Ballentine, L. E.: *Comment on 'Indirect evidence for quantum gravity'.* Phys. Rev. Lett. **48,** 522 (1982)

Dabbs, J. W. T., Harvey, J. A., Paya, D., Horstmann, H.: *Gravitational acceleration of free neutrons.* Phys. Rev., Sect. B **139,** 756–760 (1965)

Estermann, I., Simpson, O. C., Stern, O.: *The free fall of atoms and the measurement of the velocity distribution in a molecular beam of cesium atoms.* Phys. Rev. **71,** 238–249 (1947)

Hawkins, B.: *Indirect evidence for quantum gravity?* Phys. Rev. Lett. **48,** 520 (1982)

Jacobson, T.: *Quantum gravitation and the distinction between inertial mass and active gravitational mass: an experimental proposal.* In: *Abstracts of the 10th International Conference on General Relativity and Gravitation. Vol. 2,* edited by B. Bertotti, F. De Felice, A.

Pascolini, Rome, Consiglio Nazionale delle Ricerche, 990 (1983)
Koester, L.: *Absolutmessung der kohärenten Streulängen von Wasserstoff, Kohlenstoff und Chlor sowie Bestimmung der Schwerebeschleunigung für freie Neutronen mit dem Schwerkraft-Refraktometer am FRM.* Z. Physik **198,** 187–200 (1967)
Koester, L.: *Verification of the equivalence of gravitational and inertial mass for the neutron.* Phys. Rev. D **14,** 907–909 (1976)
Melissonos, A. C.: *Experimental tests of Newtonian gravity at relativistic velocities.* Nuovo Cimento B **62,** 190–202 (1981)
McReynolds, A. W.: *Gravitational acceleration of neutrons.* Phys. Rev. **83,** 172–173 (1951)
Neville, D. E.: *Experimental bounds on the coupling of torsion potentials.* Phys. Rev. D **21,** 2075–2080 (1980)
Neville, D. E.: *Experimental bounds on the coupling of massless spin-1 torsion.* Phys. Rev. D **25,** 573–576 (1982)
Nieto, M. M. and Goldman, T.: *Measurement of G/h using a superconducting ac Josephson effect.* Phys. Lett. A **79,** 449–453 (1980)
Opat, G. I.: *Molecular interferometry a possible gravitational field measuring technique.* In: *Proceedings of the 3rd Marcel Grossmann Meeting on General Relativity,* edited by Hu Ning, Beijing, Science Press 1491–1495 (1983)
Page, D. N. and Geilker, C. D.: *Indirect evidence for quantum gravity.* Phys. Rev. Lett. **47,** 979–982 (1981)
Page, D. N.: *Comments: Page responds.* Phys. Rev. Lett. **48,** 521 (1982)
Page, D. N.: *Comments: Page responds.* Phys. Rev. Lett. **48,** 523 (1982)
Page, D. N. and Geilker, C. D.: *An experimental test of quantum gravity.* In: *Quantum Structure of Space and Time,* edited by M. J. Duff and C. J. Isham, Cambridge, U.K., Cambridge University Press 1983
Reece, C. E.*: *A superconducting microwave cavity parametric converter transducer sensitive to 10^{-19} m harmonic motion.* Ph. D. Thesis, University of Rochester, UR-867 (1983)
Reece, C. E., Reiner, P. J., Melissinos, A. C.: *Parametric converters for detection of small harmonic displacements.* Nucl. Instrum. Meth. A **245,** 299–315 (1986)
Reiner, P. J. et al.*: *Search for anomalous gravitational effects at the Fermilab accelerator.* Fermilab Technical Report No. FERMILAB-Pub-84/97E, 7000.23 (1984)
Reiner, P. J.*: *Search for anomalous long range interactions at highly relativistic velocities.* Ph. D. Thesis, University of Rochester, UR-919 (1985)
Reiner, P. J., Melissinos, A. C., Rogers, J., Semertzidis, J., Wuensch, W., Fowler, W. B.: *Search for long range interactions at highly relativistic velocities.* In: *Abstracts of the 11th International Conference on General Relativity and Gravitation, Vol. 2,* Stockholm 618 (1986)
Reiner, P. J., Melissinos, A. C., Rogers, J., Semertzidis, J., Wuensch, W., Fowler, W. B.: *Search for long range interactions at highly relativistic velocities.* University of Rochester preprint No. UR-940, 16 pp. (1986)
Stedman, G. E.: *Ring interferometric tests of classical and quantum gravity.* Contemp. Phys. **26,** 311–332 (1985)

14. Measurements of the Anisotropies of *G* and of Inertial Mass

Barbour, J. S. and Easthope, P.: *On the isotropy of mass and of the universe.* Nuovo Cimento B **50,** 344–350 (1979)
Beltran-Lopez, V., Robinson, H. G., Hughes, V. W: *Improved upper limit for the anisotropy of inertial mass from a nuclear magnetic resonance experiment.* Bull. Am. Phys. Soc. **6,** 424 (1961)
Carrelli, A.: *On Mach's principle.* Nuovo Cimento **13,** 853–856 (1959)
Cheung, W. S.: *Experimental implications of Mach's principle.* M. S. Thesis, University of Virginia, 57 pp. (1978)
Cocconi, G. and Salpeter, E. E.: *A search for anisotropy of inertia.* Nuovo Cimento **10,** 646–651 (1958)
Cocconi, G. and Salpeter, E. E.: *Upper limit for the anisotropy of inertia from the Mössbauer effect.* Phys. Rev. Lett. **4,** 176–177 (1960)
Dicke, R. H.: *Experimental tests of Mach's principle.* Phys. Rev. Lett. **7,** 359–360 (1961)
Drever, R. W. P.: *A search for anisotropy of inertial mass using a free precession technique.* Philos. Mag. **6,** 683–687 (1961)
Epstein, S. T.: *On the anisotropy of inertia.* Nuovo Cimento **16,** 587–588 (1960)
Hughes, V. W., Robinson, H. G., Beltran-Lopez, V.: *Upper limit for the anisotropy of inertial mass from nuclear resonance experiments.* Phys. Rev. Lett. **4,** 342–344 (1960)
Hughes, V. W.: *Mach's principle and experiments on mass anisotropy.* In: *Gravitation and Relativity,* edited by H.-Y. Chiu and W. F. Hoffman, New York, W. A. Benjamin 106–120 (1964)
Lewis, S. A., Williams, W. L., Hughes, V. W.: *Upper limit for the anisotropy of inertial mass from nuclear-magnetic-resonance experiments.* Bull. Am. Phys. Soc. **11,** 121 (1966)
Ni, W.-T.: *Implications of Hughes-Drever experiments.* In: *Proceedings of the 1983 International School and Symposium on Precision Measurement and Gravity Experiment,* edited by W.-T. Ni, Hsinchu, Taiwan, National Tsing Hua University 519–530 (1983)
Prestage, J. D., Bollinger, J. J., Itano, W. M., Wineland, D. J.: *Limits for spatial anisotropy by use of nuclear-spin-polarized $^9Be^+$ ions.* Phys. Rev. Lett. **54,** 2387–2390 (1985)
Sherwin, C. W., Frauenfelder, H., Garwin, E. L., Lüscher, E., Margulies, S., Peacock, R. N.: *Search for the anisotropy of inertia using the Mössbauer effect in Fe^{57}.* Phys. Rev. Lett. **4,** 399–401 (1960)
Vinti, J. P.: *Possible effects of anisotropy of G on celestial orbits.* Celestial Mechanics **6,** 198–207 (1972)

Warburton, R. J. and Goodkind, J. M.: *Search for evidence of a preferred reference frame.* Astrophys. J. **208,** 881 – 886 (1976)

Williams, E. and Metherell, A. J. F.: *An experimental search for a universal gravitational anisotropy.* Cavendish Laboratory, Cambridge University, unpublished (1979)

Williams, W. L.: *High resolution nuclear magnetic resonance experiments. Part. 1: Precision measurement of the nuclear magnetic moment ratio* $\mu(He^3)/\ \mu(H')$. *Part 2: A further search for mass anisotropy.* Ph. D. Thesis, Yale University, 108 pp. (1966)

Yilmaz, H.: *Comments on Dr. Ni's talk on Hughes-Drever Experiment.* In: *Proceedings of the 1983 International School on Precision Measurement and Gravity Experiment,* edited by W.-T. Ni, Hsinchu, Taiwan, National Tsing Hua University 530 (1983)

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Davisson, C.
Kennard, E. H.
Larmor, J.
Nipher, F. E.
Sampson, R. A.
Shaw, P. E.

1917

Barton, E. H.
Boys, C. V.
Burton, C. V.
Cremieu, V.
Hayes, C.
Larmor, J.
Lindemann, F. A.
Lodge, O.
Loring, F. H.
Paterson, C. C.
Shaw, P. E.
Smith, F. E.
Thomas, J. S. G.
Todd, G. W.

1918

Barus, C.
Lodge, O.
Tangl, K.
Zeeman, P.

1919

Barus, C.
Compton, A. H.
Cremieu, V.
Donnan, F. G.
Majorana, Q.
Rutherford, E.

1920

Barus, C.
Compton, A. H.
Majorana, Q.
Nipher, F. E.
Pettersson, H.
Poynting, J. H.

1921

Barus, C.
Brush, C. F.
Majorana, Q.
Russel, H. N.

1922

Barus, C.
Brush, C. F.
Davy, N.
Eddington, A. S.
Eichelberger, W. S.
Eötvös, R.
Fekete, E.
Heyl, P. R.
Majorana, Q.
Morgan, H. R.
Pekar, D.
Potter, H. H.
Richardson, O. W.
Shaw, P. E.
Simons, L.
Wilson, H. A.
Wulf, T.

1923

Barus, C.
Boys, C. V.
Brush, C. F.
Davy, N.
Popovici, C.
Potter, H. H.
Shaw, P. E.

1924

Brush, C. F.
Heyl, P. R.

1925

Barus, C.
Heyl, P. R.

1926

Brush, C. F.
Tangl, K.

1927

Brush, C. F.
Burgess, G. K.
Heyl, P. R.
Kunz, J.
Schlomka, T.

1928

Brush, C. F.
Kogbetliantz, E.
Stern, T. E.

1929

Brush, C. F.

1930

Chazy, J.
Heyl, P. R.
Kogbetliantz, E.
Kunz, J.
Majorana, Q.
Zahradnicek, J.

1932

Zahradnicek, J.

1933

Harrington, E. A.
Zahradnicek, J.

1935

Fekete, E.

1937

Armellini, G.

1938

Armellini, G.
Bauer, L.
Heyl, P. R.

1939

Chazy, J.
Jeffreys, H.
Popovici, C.

1940

Chazy, J.

1942

Chrzanowski, P.
Heyl, P. R.
Langevin, P.

1943

Freed, S.
Jaffey, A. H.
Schultz, M. L.

1947

Estermann, I.
Simpson, O. C.
Stern, O.

1948

Armellini, G.
Teller, E.

1950

Bell
Duane, B. H.
Jacobson
Kolm

1951

McReynolds, A. W.

1953

Bleksley, A. E. H.
Eötvös, R.
Klutz, H.
Pekar, D.

1954

Heyl, P.R.
Majorana, Q.

1955

Majorana, Q.
Nijgh, G. J.
Tomaschek, R.
Wapstra, A. H.

1957

Allais, M. F. C.
Brein, R.
Dicke, R. H.
Majorana, Q.
Meissner, H.

1958

Allais, M. F. C.
Cocconi, G.
Salpeter, E. E.

1958/1959

Banna, P.

1959

Allais, M. F. C.
Carrelli, A.
Champion, F. C.
Davy, N.

1960

Beltran-Lopez, V.
Cocconi, G.
Dicke, R. H.
Epstein, S. T.
Flint, F. V.
Frauenfelder, H.
Garwin, E. L.
Hoffmann, W. F.
Hughes, V. W.
Kagal'nikova, I. I.
Krotkov, R.
Lier, R. H.
Lüscher, E.
Margulies, S.
Peacock, R. N.
Radzievskii, V. V.
Robinson, H. G.
Salpeter, E. E.
Sherwin, C. W.

1961

Beltran-Lopez, V.
Caputo, M.
Dicke, R. H.
Dobrokhotov, Y. S.
Drever, R. W. P.
Eberhard, O.
Forward, R. L.
Gruschinksky, N. P.
Hoffmann, W. F.
Hoffmann, B.
Hughes, V. W.
Krotkov, R.
Lysenko, V. I.
Pariisky, N. N.
Radzievskii, V. V.
Robinson, H. G.
Sagitov, M. U.
Schneiderov, A. J.
Sigl, R.
Thüring, B.
Tomaschek, R.

1962

Banna, P.
Caputo, M.
Chernikov, Y. A.
Chernyshov, V. I.
Cook, A. H.
Dicke, R. H.
Finzi, A.
Gruschinsky, N. P.
Hoffmann, W. F.
Kagal'nikova, N. N.
Parker, R. L.
Peebles, P. J.
Radzievskii, V. V.
Sagitov, M. U.
Shuvalov, V. V.
Thüring, B.
Tiron, M.

1963

Braginsky, V. B.
Butler, R.
Egyed, L.
Finzi, A.
Groten, E.
Harrison, J. C.
Hoffmann, W. F.
Kostko, O.
Kronberg, P.
MacDougall, J.
Mark, R.
Mason, J.
Neiman, M.
Rudenko, V. N.
Rukman, G. I.
Sandquist, A.
Tomaschek, R.

1964

Beams, J. W.
Chick, H. J.
Finzi, A.
Hughes, V. W.
Lowry, R. A.
Pochoda, P.
Sagitov, M. U.
Schwarzschild, M.
Yabushita, S.

1965

Beams, J. W.
Block, B.
Caputo, M.
Curott, D. R. F.
Dabbs, J. W. T.
Hager, C. L.
Harvey, J. A.
Horstmann, H.
Kulthau, A. R.
Lowry, R. A.
Moore, R. D.
Parker, H. M.
Paya, D.
Roos, P.
Sagitov, M. U.
Slichter, L. B.
Weiss, R.

1966

Beams, J. W.
Cameron, A. G. W.
Demarque, P. R.
Dicke, R. H.
Ezer, D.
Forward, R. L.
Hughes, V. W.
Kreuzer, L. B.
Kulthau, A. R.
Lewis, S. A.
Lowry, R. A.
Miller, L. R.
Parker, H. M.
Roeder, R. C.
Senter, J. P.
Weber, J.
Williams, W. L.

1967

Bahcall, J. N.
Beams, J. W.
Berman, D.
Bond, A.
Forward, R. L.
Gamow, G.
Koester, L.
Kulthau, A. R.
Long, D. R.
Lowry, R. A.
Miller, L. R.
Parker, H. M.
Senter, J. P.
Shaviv, G.
Southwell, W. H.
Stephenson, L. M.
Towler, W. R.

1968

Adamuti, I. A.
Alpher, R. A.
Berman, D.
Birch, F.
Braginsky, V. B.
Cohen, S. A.
Cook, A. H.
Counselman, C. C.
Finzi, A.
Forward, R. L.
Gamow, G.
Ivankin, L. G.
King, J. G.
Kreuzer, L. B.
Lowry, R. A.
Martynov, V. K.
Nash, J. H.
Neeley, A. C.

Shapiro, I. I.
Steigman, G.
Stephenson, L. M.
Stothers, R.
Tadzhidinov, K. G.
Tarakanov, Y. A.
Towe, K. M.
Towler, W. R.
Tsiang, E.
Van Dijk, H. H. J.
Van Flandern, T. C.
Warburton, R. J.
Will, C. M.

1977

Anderson, J. D.
Bagmet, A. L.
Blake, G. M.
Bleyer, U.
Braginsky, V. B.
Canuto, V. M.
Caputo, M.
Caves, C. M.
Davies, P. C. W.
De Boer, H.
Desabbata, V.
Eichendorf, W.
Estabrook, F. B.
Everitt, C. W. F.
Fitch, J. P.
Frontov, V. N.
Hirakawa, H.
Hiramatsu, S.
Hooge, F. N.
Izmaylov, V. P.
John, R. W.
Karagioz, O. V.
Kocheryan, E. G.
Koldewyn, W. A.
Liebscher, D.-E.
Lodenquai, J.
Lyttleton, R. A.
Mansfield, V.
Marchant, A.
Mikkelson, D. R.
Mucket, J. P.
Newman, M. J.
Newman, R.
Ogawa, Y.
Panov, V. I.
Pellam, J.
Philberth, K.
Poulis, J. A.
Reasonberg, R. D.
Reinhardt, M.
Rizzati, P.
Roxburgh, I. W.
Schultz, J.
Shapiro, I. I.
Spero, R. E.
Thorne, K. S.
Treder, H.-J.
Tsubono, K.
Wahlquist, H. D.
Yamaguchi, Y.

1978

Anderson, J. D.
Barrow, J. D.
Beams, J. W.
Blake, G. M.
Blinnikov, S. I.
Cerofolini, G. F.
Chesnokova, T. S.
Cheung, W. S.
Desabbata, V.
Dmitrieva, T. I.
Fitch, J. P.
Gillies, G. T.
Gittus, J. H.
Goldstein, Jr., S. J.
Golizinskii, L. W.
Halpern, L.
Hirakawa, H.
Hooge, F. N.
Hu, C.-C.
Keesey, M. S. W.
Lau, E. L.
Liu, F.-H.
Liu, W.-N.
Long, C.
Lyttleton, R. A.
Mapoles, E. R.
McElhinny, M. W.
Milyukov, V. K.
Monakhov, E. A.
Muller, P. H.
Nazarenko, V. S.
Newhall, X X.
Ni, W.-T.
Ogawa, Y.
Oide, K.
Paik, H. J.
Pontikis, C.
Poulis, J. A.
Reasonberg, R. D.
Ritter, R. C.
Rizzati, P.
Rood, R. T.
Sagitov, M. U.
Shapiro, I. I.
Sinclair, W. S.
Stacey, F. D.
Standish, E. M.
Stevenson, D. J.
Taylor, S. R.
Van Flandern, T. C.
Wang, K. Y.
Wesson, P. S.
Williams, J. G.
Yang, C.-H.
Yoder, C. F.
Yu, H.-T.

1979

Anderson, J. D.
Barbour, J. S.
Beaudet, G.
Bekenstein, J. D.
Bishop, N. T.
Canuto, V.
Canuto, V. M.
Carignan, C.
Carr, B. J.
Caves, C. M.
Chesnokova, T. S.
De Boer, H.
Dmitrieva, T. I.
Easthope, P.
Eötvös, R.
Esposito, P. B.
Estabrook, F. B.
Farinella, P.
Feinberg, G.
Fialovszky, L.
Frontov, V. N.
Fujimoto, M.-K.
Hirakawa, H.
Hoskins, J. K.
Hsieh, S.-H.
Hu, C.-C.
Lambeck, K.
Liu, F.-H.
Liu, W.-N.
Martin, C. F.
Metherell, A. J. F.
Milani, A.
Mills, Jr., A. P.
Milyukov, V. K.
Monakhov, E. A.
Nazarenko, V. S.
Newman, R.
Ni, W.-T.
Nobili, A. M.
Oh, I. H.
Owen, J. R.
Paik, H. J.
Panov, V. I.
Rees, M. J.
Rood, R. T.
Rudenko, V. N.
Sagitov, M. U.
Schramm, D. N.
Shey, Y.-C.
Sirois, A.
Spero, R. E.
Stegna, L.
Steigman, G.
Sucher, J.
Tadzhidinov, K. G.
Treder, H.-J.
Williams, E.
Woodward, J. F.
Yang, C.-H.
Yang, J.
Yourgrau, W.
Yu, H.-T.

1980

Canuto, V. M.
Chan, H. A.
Cheung, W. S.
Cook, A. H.
Dannehold, T.
De Boer, H.
Dirac, P. A. M.
Farinella, P.
Ferrari, A. J.
Frontov, V. N.
Gillies, G. T.
Goldman, T.
Haars, H.
Hirakawa, H.
Hoskins, J. K.
Hsieh, S.-H.
Jones, Jr., G. R.
Levitt, L. S.
Leyh, C. H.
Long, D. R.
Michaelis, W.
Milani, A.
Mulholland, J. D.
Narlikar, J. V.
Neville, D. E.
Newman, R.
Ni, W.-T.
Nieto, M. M.
Nobili, A. M.
Oide, K.
Paik, H. J.
Panov, V. I.
Pellam, J.
Rana, N. C.
Ritter, R. C.
Schlimme, E.
Schultz, J.
Shapiro, I. I.
Sinclair, W. S.
Sjogren, W. L.
Spero, R. E.
Suzuki, T.
Tsubono, K.
Wesson, P. S.
Williams, J. G.
Woodward, J. F.

1981

Alpher, R. A.
Augustin, R.
Barrow, J. D.
Canuto, V. M.
Carey, S. W.
Chen, Y. T.
Chow, T. L.
Cowsik, R.
Dannehold, T. L.
Davies, R. D.
De Boer, H.
Fialovszky, L.
Fujii, Y.
Geilker, C. D.
Gibbons, G. W.
Gillies, G. T.
Goodson, R. E.
Haars, H.
Hirakawa, H.
Holding, S. C.
Hut, P.
Izmaylov, V. P.
Jones, G. R. Jr.
Karagioz, O. V.
Kimura, S.
Kononenko, I. V.
Kuroda, K.
Lapiedra, R.
Long, D. R.

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