On possible changes in the air state during TK: a theoretical framework for future investigations

Ademir Xavier Jr[1]

[1] Brazilian Space Agency, Brasilia-DF, Brazil
[*] Corresponding author: xavnet2@gmail.com

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Among the large body of evidences accumulated in the paranormal literature, telekinesis (TK) is the most remarkable. Hidden relationships were postulated to connect the proper understanding of transport phenomena and the nature and production of a fluid substance called "ectoplasm". However, with the rise of quantum physics and the possible influence of "mind-over-matter", such old explanations were abandoned. In this paper, I develop theoretical considerations about the TK effect using thermodynamics and energy balance, arguing that if energy is converted - through an intervening fluid - by mediums in a variety of degrees, this can also happen at the cost of changing the internal energy of the surrounding gas. I hypothesize the TK fluid as acting upon the surrounding air, which serves then as a kind of interface for the phenomena. Then I discuss the important consequence of TK effect being suppressed by vacuum, since no intervening fluid would exists to move the object. I provide a thermodynamic equivalent system to account for the vacuum limits necessary to suppress TK.

OCIS codes: *Fluid, telekinesis, physical mediumship, anomaly*

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Telekinesis (also called Macro-PK), physical manifestations and materializations are among the most extraordinary phenomena of the so-called paranormal realm. Ancient descriptions of movement of objects, direct voice, appearance of ghost hands and human figures populate world cultures (Hyslop, 1918, Doyle, 1926) since all times and are part of the literature of spiritualism (Doyle, 1926), metapsychics and, more recently, poltergeists in parapsychology (Taboas & Alvarado, 1981, Owen, 1964). It is believed these phenomena can only occur under the presence of certain people traditionally called mediums of physical effects (MPEs, Rhine, 1963) or, more generally, TK agents (Rhine, 1970, Ibison, 2000).

Considerable effort has been dedicated to debunk these phenomena (Carroll, 2011, Charpak & Broch, 2004) or associating them with fraud and trickery. However, there is an enormous variety of reports (Tymn, 2009, Schwarz, 1985, Carington, 1921, Wiseman & Haraldsson, 1995, Haraldsson & Wiseman, 1996, Richards, 1982) about their existence along with a substance or a fluid (Schrenck-Notzing, 1920, Alvarado, 2004) allegedly produced by MPEs (Crookes, 1872, Carrington, 1921). There has been much discussion (Alvarado, 2006) about the role played by this substance in the heyday of spiritualism (Alvarado & Nahm, 2011) and the empirical phase lead by the Society of Psychic Research still in the XIX century. Today, the idea of "bioenergy fields" (Braud, 1991, Kaivarainen, 2003) or non-local quantum fields (Jahn & Dunne, 1989, Josephson, 1975, Radin & Nelson, 1989, Roll & Persinger, 1998) have been proposed as alternative explanations for occurrences such as PK, TK and healing (Bengston & Krinsley, 2000). However, it seems there is still space for fresh theoretical ideas (Cornell & Gauld 1961, Puskin 1976, Brovetto & Maxia, 2008) and design of new experimental procedures to account for present and past reports.

MPEs may be seen as central agents of telekinesis understood as the ability to move objects at distance. In fact, given past reports, a "power scale" seems to exist: weak MPEs can only move light bodies (Keil & Pratt, 1973) while strong MPEs (Alvarado, 2003) would be able to levitate large objects (Batcheldor, 1966, Barham, 1988, Watkins & Watkins, 1973), produce combustion of bodies, sounds (Whitton, 1975, Colvin, 2010) and other effects (Cox, 1961, Campbell & Murray, 2007). Although the process of energy conversion involved in all these occurrences is unknown, it is reasonable to admit the physical laws of conservation do apply. This implies in assuming that energy from the MPE (understood as a biochemical source) is transformed into kinetic or potential energy (in the case of object levitation, movement etc). Similar to all process of energy conversion, part of the energy would be dissipated in the environment according to Clausius' law, a principle that predicts that an increase in the entropy is involved in the process. MPEs, however, are not isolated systems and subtle interactions may be involved between a MPE and its environment. Toward the aim of better understanding these phenomena, we believe the effort should involve the study of the atmosphere surrounding the source that possibly exhibits quite distinct properties as that of "ordinary" air.

1. TK AND THE ENVIRONMENT: THERMODYNAMIC SIGNATURES OF ANOMALOUS WORK

We propose here is to physically compare the *environment* where the source is with the environment in the absence of the source *or* the presence of an entity biologically similar but lacking the putative effects. Let S be the system formed by a living body (LB, i. e., a human being) and the environment E, that is, $S = LB + E$. LB is also a source of heat, gases and radiation due to internal biochemical work (Haynie, 2001). For thermodynamically closed environments, an increase in the average temperature of S is expected if $T_{LB} > T_E$ after LB is put inside E. A pressure increase is also expected if both systems are initially under the same pressure. LB undergoes changes in its internal states producing, for example, gases as byproducts of metabolic reactions. Also, an increase in the radiation field surrounding LB is expected as LB attains equilibrium with the container walls. If S is absolutely closed in the *thermodynamic sense*, then exchange of heat or molecules is not possible between S and the external world. On the other hand, a perfect thermal interface between S and the external world can be admitted, but allowing for molecular exchange. Then, if $T_{LB} > T_E$, only thermodynamic equilibrium is reached and the whole process is isobaric.

LB can also do work inside E in which case S undergoes a change in its internal energy according to the first law (Reif, 2008). If no external heat is added (since S is isolated), then the variation in the internal energy of S will equate the work done by LB in the container interior. For example, suppose that LB vertically rises up a table weighting 490.3 N (corresponding to a mass of 50 kg under the Earth's gravity) 1.5 m high, then the change in the internal energy of S will be 735.5 J (or 175.7 cal). Moreover, according to the second law of thermodynamics (Clausius' law), another property called entropy is increased. By rising the weight, LB causes a modification in the distribution of internal states of S: in particular, the molecules of the gas surrounding LB will change their states with measurable consequences. Chemical energy is converted into work by a process that modifies the distribution of temperature surrounding the source. Therefore, even if the final state of the weight is inaccessible, we could infer that work was done by measuring the gas internal energy or by following the changes in the local temperature distribution of the gas. If the process is isobaric, local temperature changes in the gas will be observed, for example, by tracking subtle changes in the gas density.

Now, let us assume that the living organism is a MPE (or a TK-agent) and that the interface between the external world and E is also isobaric, but radiation and heat cannot be exchanged between the external world and the system interface ($S' = MPE + E$). Being a living organism, the MPE is subjected to the same thermodynamic description. However, as past and modern accounts describe (Crawford, 1921, Gaither Pratt & Keil, 1973, Owen, 1974), MPEs can ostensibly change S' in an observable way by doing "anomalous work". For example, with no ordinary contact, an MPE could vertically rise a table (Batchelor 1966, Botazzi, 2011) weighting 490.3 N, again, 1.5 m high. Now, no matter the kind of interaction is postulated between the MPE and its environment, if no heat is externally added, a change in the internal energy of S' by 735.5 J is expected because the first law should also hold. Possibly, chemical energy is transferred by the MPE to the gas such that the internal energy of S' will change by exactly the total amount of anomalous work done and one should also expect an increase in the entropy of S'. Therefore, by studying the thermodynamic properties of the gas surrounding the MPE it would be possible to extract information about whatever work done by it.

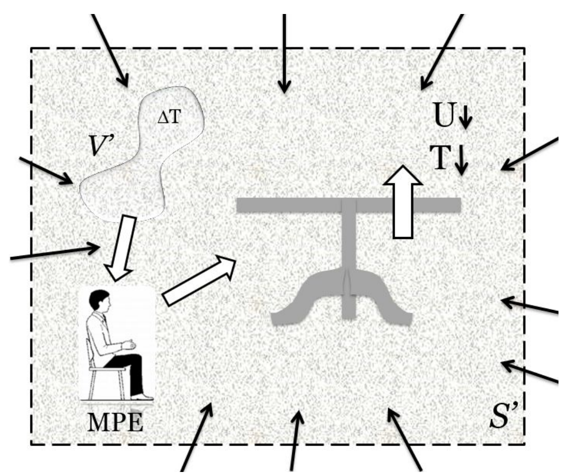

Fig. 1. A MPE in an isolated system S' may modify the thermodynamic state of the air by anomalously moving an object (temperature drop, internal energy reduction and diffusion of air molecules through the walls causing "wind blows"). The "anomalous work" during TK may be followed by changes in the thermodynamic state of the air volume at pressure p_0 or part of this volume, V', resulting in larger temperature drops ΔT confined to the volume.

However, besides the MPE, there are other sources of energy available inside S' as the very volume of gas at a certain initial temperature (in the thermodynamic sense). Then, a possible path for the phenomenon is the TK agent to (be able to) transfer energy from the gas to the process through some mechanism which is obviously unknown. Let us assume the room volume V= 27 m^3 and contains dry air at $T_0 = 298.15K$ (25^{o}C or 77^{o}F). Internal energy of the air can be converted into the work of levitating a weight of 490.3 N 1.5 m above ground level, with an associated temperature change ΔT = -0.023K at constant pressure. If only part of the room's volume (say $V' < V$) provides the energy (see Figure 1), the temperature change would be larger in such volume; for example, for V'= 0.125 m^3 [=(0.5m)^3], ΔT = -4.94K. Therefore, the magnitude of temperature drop depends on the gas volume involved in the energy transference. If the container walls of S' are not rigid, a shrink of about 7.67$\times$10^{-3} % in the volume would be noticed. In a real situation, the container where the MPE is can exchange molecules with the external world. To account for the variation in the room volume V due to the temperature drop, a tiny "wind blow" (Figure 1) would be detected corresponding to the diffusion of 0.092 moles of air (about 2 liters or 0.5 gal) through S' walls. Interesting enough, some past and modern accounts have described temperature drops and the presence of unexpected air motion (Carrington, 1909, Botazzi, 2011). Since MPEs are out of equilibrium systems, in order to produce a given mechanical effect (object motion) a much larger amount of energy may be involved, resulting in pronounced environmental effects.

2. CONJECTURE ABOUT THE MECHANISM OF CONTACTLESS MOVEMENT.

In the past, W. Crookes devised sensible experiments to isolate what he called "psychic force" (Crookes, 1871, Crookes, 1872, Lauceston Examinier 1899, Stewart, 1985, Oppenheim, 1986, Luckhurst 2002). From a purely logical point of view, if an invisible force or substance can be conceived as acting directly on a body, there is no objection for this force or substance to act upon the very molecules of air surrounding the MPE. A possible way to understand the TK effect is then in the form of a hidden interaction between something[1] produced by the MPE and the surrounding air. The gas inside S' would work as an "intervening medium" between the MPE and the body in motion. The advantage of this approach is that other peculiar effects like spontaneous pyrolysis reported, for example, in Poltergeist phenomena (Price 1945) could be accommodated in a single physical mechanism of explanation. In addition, the appearance of anomalous sound effects like noises (Whitton, 1975, Colvin, 2010) could be understood as changes in the air pressure of S', since sound itself is a mechanical density wave propagating in the air.

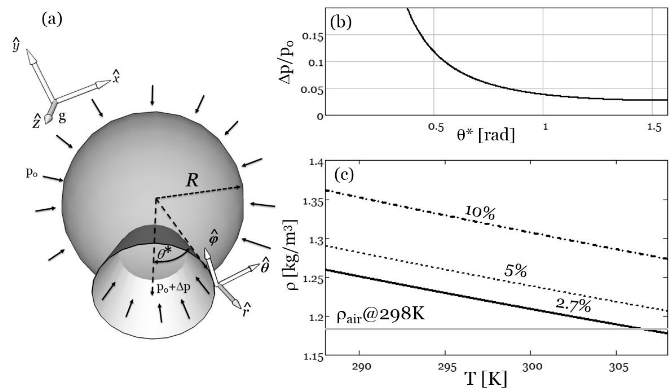

Fig. 2. (a) Schematic representation of an anisotropic levitating pressure field around a spherical object of radius R. The pressure distribution is given by Eq. 2, gravity points toward the z-axis as shown and the pressure anisotropy is entirely radial (no $\hat{\theta}$ and $\hat{\varphi}$ dependence). (b) Relative pressure difference (in relation to the atmospheric pressure p_0) as a function of the actuation angle $\theta^\star$. (c) Dependence on air density as a function of temperature necessary to create the relative pressure differences of 2.7% (thick black line), 5% (dotted line) and 10% (dash dotted line). The grey line is the air density at 298K.

In order to investigate a possible route for a connection, we consider the forces acting on a body of volume V immersed in a fluid. Presently, only two kinds of forces are recognized as influencing a body's motion: body forces (such as gravity, magnetic induction etc) and surface forces (through direct contact at the body's surface). Applying Newton's second law, the vector acceleration **a** of a body with uniform density ρ and volume V can be written by the following expression

$$\mathbf{a} = \frac{1}{\rho V} \int\int_V p(-\mathbf{n}) dS + \frac{1}{V} \int\int_V \Phi \mathbf{n} dS, \quad (1)$$

with Φ the gravitational potential[2] and **n** a vector normal to the body differential surface dS. The resulting acceleration is calculated as *surface integrals* in relation to the body center of mass (assuming the distribution of surface forces does not make the body rotate). As a consequence, the second integral in Eq. 1 is equal to **g**, the gravity acceleration. Under ordinary conditions, since p is an isotropic field, the pressure integral is zero[3], which does not mean that the force on the object surface is negligible[4].

[1]The properties of ectoplasm, described as of fluidic nature by the literature, seem to accommodate the notion of diffusiveness in the surrounding medium.

[2]In Eq. 1, gravity was written as an integral of a surface function (the gravity potential), thanks to divergence theorem (Kellog 2012). This form is however valid provided the body density is uniform.

[3]That is, if the body density is much larger than the fluid density, differences in the pressure distribution between top and bottom body parts are not sufficient to sustain the body weight. Then, the pressure can be dropped from the integral in Eq.1 which becomes zero.

[4]For the standard atmospheric pressure, 101325 Pa, the force on 1

As a consequence, any non-null acceleration requires an anisotropic $p(-\mathbf{n})$. To provide some numerical values, we consider a sphere of radius R, subjected to an isotropic pressure field p_0 except on an area on its surface, delimited by the actuation polar angle $\theta^\star$. On this surface, the pressure is $p_0 + \Delta p$ and one can calculate the surface gauge distribution Δp necessary to levitate the sphere (that is, to make $\mathbf{a} = 0$ in Eq. 1). Using spherical coordinates with orientation vectors $(\hat{r}, \hat{\theta}, \hat{\varphi})$ on the surface (Figure 2(a)), the anisotropic field can be written as

$$p(\theta) = \begin{cases} -(p_0 + \Delta p)\hat{r} & \text{if } 0 \leq \theta \leq \theta^\star, \\ -p_0\hat{r} & \text{if } \theta^\star < \theta \leq \pi, \end{cases} \tag{2}$$

and the equilibrium condition becomes

$$\Delta p \int_0^{2\pi} \int_0^{\theta^\star} (\sin\theta\cos\varphi\hat{x} + \sin\theta\sin\varphi\hat{y} + \cos\theta\hat{z}) \sin\theta d\theta d\varphi = \frac{4}{3}\pi R\rho g\hat{z} \tag{3}$$

Force components along $\hat{x}$ and $\hat{y}$ are zero so that only the $\hat{z}$ component is relevant. As a consequence the relative pressure gauge is

$$\frac{\Delta p}{p_0} = \frac{4\rho g R}{3nR_g T_0 \sin^2\theta^\star}, \tag{4}$$

with R_g the gas constant (=287.058 J/kg K), n the air density and T_0 the air temperature. This equation implies a linear dependence of the pressure induced force with the object density and its size. The gauge pressure obviously diverges as $\theta^\star \to 0$ (see Figure 2(b)), but experiences a minimum at $\theta^\star = \pi/2$, that is the force should be applied to single hemisphere. For a sphere with R = 30 cm (or 11.8 in), made of wood ($\rho \approx 700$ kg/m^3) in the air at sea level and T_0 = 25°C (77°F), $\Delta p/p_0$=2.7%. Since the density of iron in 10 times that of wood, the relative gauge variation for a iron sphere is close to 30%. As shown in Figure 2(c), a relation between the gas temperature and density can be established in order to produce a given pressure change (as represented by the lines and indicated amounts 2.7%, 5% and 10%), implying that the effect might result in heating the object's surface.

If, instead of a sphere we regarded a cylinder with radius R and height h_c, the equivalent formula for the relative gauge change is

$$\frac{\Delta p}{p_0} = \frac{\rho g h_c}{nR_g T_0 \zeta} \tag{5}$$

with ζ the area fraction below the cylinder area actuated by the force. Again, the effect does not depend on the cylinder radius but only on its height. The pressure difference is a minimum if the entire bottom area is involved ($\zeta = 1$). This is the case of a circular table with $h_c << R$ and in Figure 3 we represent the same environment of Figure 1 where a table of area A and weight[5] W is hold in the air without contact. As calculated previously, a suitable thermodynamic interface is provided by admitting the existence of a layer of air below the object where a change in the air density arises producing the movement. In order to roughly estimate the relation between the thermodynamic variables, we assume the layer has thickness equal to h, or, in other words, the entire air column below the table is involved in the phenomenon. The pressure on the table top is p_0, opposed by a pressure $p_0 + \Delta p$ on the bottom. Using $\rho h_c g = \Delta p$ and Eq. 5, the *average difference* in air density below the object is ($\zeta = 1$)

$$\Delta n = \frac{\rho g h_c}{R_g T_0}. \tag{6}$$

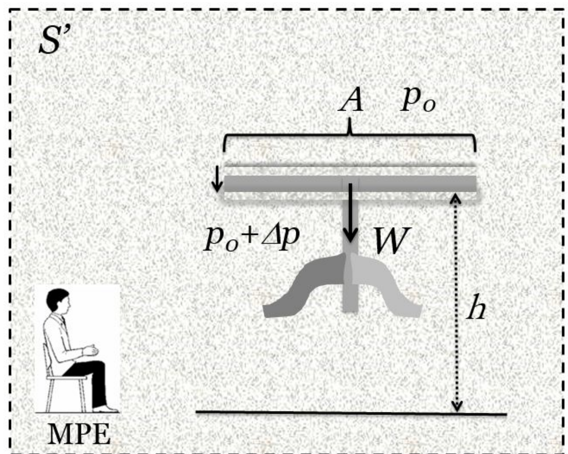

Fig. 3. Variables used to describe the levitation of an object by TK with weight W and area A as a force arising from the pressure difference, Δp, between object top and bottom surfaces.

Using data of Section 2, we find $\Delta n = 2.86 \times 10^{-3}$kg/m^3. This amounts to a density change of about 0.24% in relation to the average air density n. A representative equilibrium height may be written by

$$h = \frac{N_b R_g T_0}{W + nR_g T_0 A}, \tag{7}$$

where N_b is the total mass of air below the object. This equation predicts the amplitude of TK motion as inversely proportional to the object weight (in accordance to Eq. 1) and directly proportional to the temperature and total amount of molecules below the table. Temperature dependence may be emphasized by the derivative

$$\frac{\partial h}{\partial T} = \frac{N_b W R}{(W + nRT_0A)^2}, \tag{8}$$

cm^2 of a body is 10.1 N. If this unbalanced force is applied to an object with m = 100 g, an acceleration of 101.3 m/s^2 (or 332.4 ft/s^2) will be observed.

[5] With $W = Ah_c\rho g$.

which is however small: for the same table of 50 kg, $\partial h/\partial T \approx 4.03\mu$m/K at 298.15K (25^{o}C), or a change of 50 K elevates the table by about 0.2 mm, implying that large temperature differences are required to enhance the effect at least for such large object masses. Eq. 8 represents a static situation, anomalous movement along the z-axis requires starting from a different equation: $\Delta p = \rho h_c a$, with a the desired acceleration (the principle is however the same). Since matter is necessary to drive motion, Eq. 8 implies that TK is severely limited for objects with plane faces on flat ground. In this sense, a minimum air layer is necessary and the effect magnitude would depend on the object shape.

3. THERMODYNAMIC EQUIVALENT AND VACUUM SUPPRESSION LIMITS

Under the hypothesis of anomalous orthogonal forces on the object's surface, levitation would be impaired when the object main side is in contact with a flat ground (but side movement is allowed). Moreover, if the molecules surrounding the object provide the physical interface for the phenomenon, then *in the absence of air, TK would be suppressed*. In fact, no phenomena of the sort produced by MPEs would take place in vacuum and this is a testable hypothesis. However, it is reasonable to admit a critical level of vacuum above which TK would be strongly reduced. A possible way of calculating the necessary pressure drop is to make a parallel with the vacuum effect on the amplitude of a sound wave (of a given frequency). It is known (Reif, 2008, Fay, 1940, Weaver & Pao, 1981) that the dependency is linear with air density, so that the suppression would be limited by the sensibility threshold of the detector. Here we further explore the thermodynamic equivalent system applied to the observable effect of anomalous transport.

The air state surrounding a levitating object during TK may be compared to that of a gas separated by an equivalent frictionless piston of weight W dividing an isolated container into two chambers as shown in Figure 4 (in fact, if friction is admitted, it should be equated to air friction). At a given temperature, there is an equilibrium height (h) separating the total container volume AH. As $p_0 \to 0$, a vacuum level should exist below which contactless static equilibrium is no longer possible. However, as air is extracted continuously from both separations (through two valves as shown), there is a relationship between the total number of molecules in the top and bottom containers so that the piston remains static. Initially, if $h \neq 0$, there is a non-null amount of molecules below the piston sustaining the piston weight. Moreover, it is intuitive that the pressure drop in the top container must be larger than the corresponding drop in the bottom part for the piston to remain still.

For the system of Figure 4, the equilibrium height as a function of total number of molecules N_1 and N_2 in the bottom and top containers, respectively, is given by

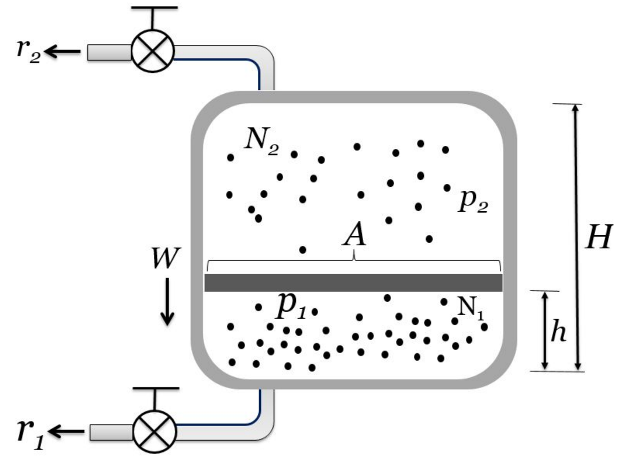

Fig. 4. Thermodynamic equivalent for the process of removing the surrounding air of a levitating object during TK. The system is divided by a frictionless piston of weight W and area A so that N_1 molecules exist in the bottom part at pressure p_1 while N_2 molecules are in the top container at pressure p_2. If r_2 and r_1 are the rates of air extraction at the top and bottom parts respectively, there is a constraint of the type $r_2 = f(r_1)$ for the piston to remain static.

$$h^2\gamma - h(N_1 + N_2 + \gamma H) + N_1 H = 0, \quad (9)$$

where $\gamma = W/RT$. The only possible solution is the negative root

$$h = \frac{1}{2\gamma}\left[(N_1 + N_2 + \gamma H) - \sqrt{G(H, N_1, N_2)}\right], \quad (10)$$

with

$$G(H, N_1, N_2) = (N_1 + N_2)^2 + \gamma^2 H^2 + 2\gamma H(N_2 - N_1). \quad (11)$$

Before showing results for the general case, some limiting situations may be considered. For example, for $\gamma \to 0$, which correspond to the limit of extremely light objects or no gravity, the equilibrium position will be

$$h^{(0)} = H\frac{N_1}{N_1 + N_2}. \quad (12)$$

So, in general, the height position will depend on geometrical factors besides the total number of molecules in both containers, that is, $h = h(N_1, N_2)$. As an extension for extremely light objects, an expansion of the root in Eq.(10) to first order in γ results in

$$h^{(1)} = H\frac{N_1}{N_1 + N_2} - \gamma H^2\frac{N_1 N_2}{(N_1 + N_2)^3}, \quad (13)$$

showing a negative signal in the second term since, as the pressure drops, the piston should fall. Moreover, since γ

is inversely proportional to the temperature, as the temperature rises, the dependence with the object weight is reduced. Higher order terms can be included by noticing that

$$\sqrt{G(H,N_1,N_2)} \approx (N_1+N_2) - \gamma H \frac{N_1-N_2}{N_1+N_2} + 2\gamma^2 H^2 \frac{N_1 N_2}{(N_1+N_2)^3} + 2\gamma^3 H^3 \frac{N_1 N_2 (N_1^2 - N_2^2)}{(N_1+N_2)^5} - 2\gamma^4 H^4 \frac{N_1 N_2 (N_1^2 - 3N_1N_2 + N_2^2)}{(N_1+N_2)^7} + \ldots$$

which is an expansion in terms of γH.

When air is extracted, the pumping rates r_1 and r_2 should be adjusted so that h remains fixed, that is

$$\frac{\partial h}{\partial N_1}\frac{dN_1}{dt} + \frac{\partial h}{\partial N_2}\frac{dN_2}{dt} = 0, \quad \textbf{(14)}$$

or, simply

$$r_1^\star = -r_2^\star \left(\frac{\partial h}{\partial N_2}\right)\left(\frac{\partial h}{\partial N_1}\right)^{-1}. \quad \textbf{(15)}$$

Applying this equation for the case of light objects, one finds that the logarithmic rates of pumping at each container should be equal, that is,

$$\frac{d \ln N_1}{dt} = \frac{d \ln N_2}{dt}, \quad \textbf{(16)}$$

confirming that, depending on the pressure difference between the top and bottom chambers (e. g., as given by Eq. 16), the piston may remain motionless. The equivalent equilibrium equation (Eq.14) for first order terms is

$$r_1^\star = r_2^\star \frac{N_1}{N_2}\left[\frac{(N_1+N_2)^2 + \gamma H(N_1 - 2N_2)}{(N_1+N_2)^2 - \gamma H(N_2 - 2N_1)}\right]. \quad \textbf{(17)}$$

On the contrary, if we assume TK is unable to keep the right pressure difference between the body parts, the resulting vacuum effect may be calculated by making $N_1 \propto \exp(-\alpha t)$ and $N_2 \propto \exp(-\alpha t)$, with α a vacuum rate constant. Using these laws in the equations above, a relation between pressure and the equilibrium height is obtained. In equations above, the equilibrium height was given in terms of the total number of molecules but, using the equation of state, these numbers are in fact functions of the pressure difference and temperature. Intuitively one expects, however, that the remaining number of molecules in the lower chamber cannot sustain the object depending on its weight, when a limit is reached. In the top chamber, this is shown in Figure 5 for three different masses at 25^{o}C (77^{o}F) and H=1m. The solution of Eq. (10) is h $\approx$ 0.5m for all masses and p = 1 atm, since N_1 was initially set equal to N_2. As air molecules are removed from both chambers at the same rate, the pressure decreases and the object falls but the vacuum level necessary to suppress the effect for lighter objects is considerably stronger. A shift of 10 cm is attained at p = 4$\times$10^{-3}Torr for a 50 kg object, while for m = 1kg the same shift is only reached at p= 1$\times$10^{-4}Torr. Therefore, if there is any connection between TK and the air, those may be the vacuum levels possibly required to severely attenuate TK given the proposed masses.

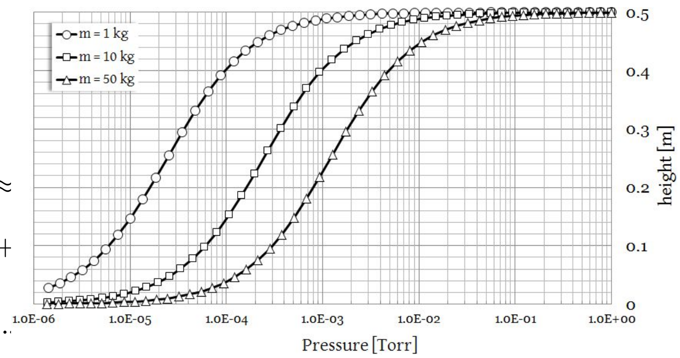

Fig. 5. Height of three distinct masses ($-\circ-$ 1 kg, $-\square-$ 10 kg and $-\triangle-$50 kg) as a function of the vacuum level in Torr (notice the logarithmic scale) in the top container for the thermodynamic equivalent. For this simulation, H=1 m, T=25°C and $N_1 = N_2$ initially.

4. CONCLUDING REMARKS

Energy must come from somewhere in order to move the object during TK, and this is independent of the theoretical framework used as explanation, be it fluid action or quantum mechanics (Brovetto & Maxia, 2008, Josephson, 1975). Such flow might happen in certain contexts such as haunting investigation (Andrews, 1977), where there is a tradition in monitoring environmental variables like temperature (Radin & Rebman, 1996, Williams et al, 2008) and the magnetic local field (Wiseman et al 2002), as suggested by correlations among geophysical, meteorological and physical variables and these effects (Cornell & Gauld 1961). The results of this paper addresses in particular the cases where a MPE is present and interacts with the environment (Botazzi, 2011, Campbell & Murray, 2007), which is not apparent during hauntings. Even in these cases however it is possible that the true energy source is hidden in the vicinity and associated again to a LB.

In this paper, we have provided some examples and calculations showing the predicted effects of assuming air molecules to be responsible for the physical interface during TK though a yet unknown mechanism. The influence path can be a direct action at distance via some unknown *body force* or an indirect change in the surrounding fluid which in turn would make the body move via a *surface force*. This second option was explored given the variety of thermodynamic changes in the air as described in many TK occurrences. Thus, assuming energy conservation, a thermodynamic description of the environment where a MPE is was constructed showing that the immediate vicinity of the TK agent might be affected by the realization of "anomalous" work. Some parallels between the thermodynamic effects and historically observed physical phenomena were suggested, indicating a possible link. Consequently, we conjecture TK may be suppressed in vacuum of a certain level as described in Section 4. Many predictions of this work implicitly lead to the need of controlling the environment. For example, it is implicitly assumed that pressure could be reduced in macro-PK investigations, which is something never done before, given the rarity of MPEs nowadays and the controversial and very specific conditions under which TK has been reported to occur. However, a positive validation of this suggested test would substantially support our hypothesis.

We recall that, under the continuum hypothesis and normal conditions, the distribution of matter around the body is uniform. However, pressure is in fact a measure of molecular speed dispersion or, numerically (Vincenti & Kruger, 1965, Reif, 2008, Blundell & Blundell, 2010) $p = 1/3nm\langle v\rangle^2$, with m the molecule mass (for simplicity, assume a monoatomic gas). Since $1/2m\langle v\rangle^2 = kT$, the dispersion relation gives rise to $p = nkT$ as the equation of state (k is Boltzmann constant). The relation between p and the average molecular speed $\langle v\rangle$ is in fact a particular form of the pressure field which involves the statistical distribution of molecule speeds, $f(\mathbf{v})$, or (Reif, 2008)

$$p = \iiint_A f(\mathbf{v}) m v^2 dv. \quad \textbf{(18)}$$

Equation above is completely general and $f(\mathbf{v})$ may be given by either a classical or quantum mechanic distribution. Therefore, a connection with microphysics is established by assuming MPE may actuate on the surrounding fluid by changing the (local) distribution $f(\mathbf{v})$. Several physical effects offer examples of equivalent object levitation by surface forces (Brandt, 2001, Hashimoto et al, 1998, Swanson, 1961).

It is also important to emphasize that the process of energy conversion involving MPEs should not be admitted as *reversible*. Irreversibility (Reif, 2008, Nicolis & Prigogine, 1977) implies that part of the energy extracted from the source goes somewhere else (for instance, is converted into the gas internal energy and lost, that is, *dissipated*), besides doing the final work. Therefore, the amount of energy necessary to produce a given mechanical work is much larger than the energy equivalent associated to the observed effect. Hence, in the example of the table, the energy liberated by the MPE and distributed elsewhere is much larger than mgh or the change in the object potential energy. Irreversibility implies in the impossibility of producing the final effect and *nothing else*. Therefore, as a consequence of irreversibility, secondary effects could take place even in absence of any detectable effect. As a practical application of this conclusion, genuine TK could be validated by closely monitoring the environment, since many "thermodynamic signatures" would lack in the case of motion produced by any type of fraudulent action.

As a final historical observation, some readers may notice the resemblance between the forces invoked in the present analysis and the physical mechanism underlying Crookes radiometer (Crookes 1874, Crookes 1875, Crookes 1876, Woodruff 1968). Others could also suggest a possible connection between this device (invented by Crookes himself) and Crookes' effort towards characterizing his "psychic force", but there is no documented support for this relationship (Ferreira 2004). Contrary to widespread intuition (Woodruff 1968), the light mill is not moved by photon's collision with its paddles, but by a non-null pressure gradient (Scandura et al 2007) between paddle dark and white faces (see Figure 1 in Chen et al 2012) in a condition attained after illumination by a radiation source. In this case, energy is extracted from the radiating field, which heats the paddles, in particular at their edges (Selden 2009, Passian et al 2003), and provides the pressure gradient to turn the "light mill". In addition, a certain vacuum level is necessary inside the radiometer bulb in order to suppress friction and allow the motion. And, as the vacuum level is increased, by exactly the same reason, insufficient number of molecules, the device stops working. Crookes radiometer played an important role at the end of the XIXth century, having instigated the curiosity of important physicists (Maxwell 1879, Einstein 1924). Anyway, it would be fascinating to conclude that Crookes himself would have already provided a device somewhat embedding a potential principle to explain TK.

REFERENCES

1. Alvarado, C. (2003). The Concept of Survival of Bodily Death and the Development of Parapsychology. *Journal of the Society for Psychical Research*, 67(2). 65-95.
2. Alvarado, C. S. (2004). Frederic W. H. Myers on the projection of vital energy. *Paranormal Review*, 30, 23-28.
3. Alvarado, C. S. (2006). Human radiations: concepts of force in mesmerism, spiritualism and psychical research. *Journal of the Society for Psychical Research*, 70, 138-162.
4. Alvarado, C. S. & Nahm, M. (2011). Psychic Phenomena and the Vital Force: Hereward Carrington on "Vital Energy and Psychical Phenomena". *Journal of the Society for Psychical Research*, 75(903), 91.
5. Andrews, A. K. (1977). Use of Instrumentation to detect temperature-field in Haunting, Poltergeist and Experimental PK Investigations. *Journal of the American Society for Psychical Research*, 71(3), 333-334.
6. Barham, A. (1988). The Crawford Legacy Part II: Recent research in macro-PK with special reference to the work of Batcheldor and Brookes-Smith. *Journal of the Society for Psychical Research*, 55(813), 196-207.
7. Batcheldor K. J. (1966), Report on a Case of Table Levitation and Associated Phenomena, *Journal of the Society for Psychical Research*, 43(729), 339-356.
8. Bengston, W. F.& Krinsley, D. (2000). The Effect of the 'Laying On of Hands' on Transplanted Breast Cancer in Mice, *Journal of Scientific Exploration*, 14(3), 353-364.
9. Blundell, S., & Blundell, K. M. (2010). Concepts in thermal physics. Oxford University Press on Demand.
10. Bottazzi, F. (2011). *Mediumistic Phenomena: Observed in a Series of Sessions with Eusapia Palladino*. Icrl Press.
11. Braud, W. G. (1991). Consciousness interactions with remote biological systems: Anomalous intentionality effects. *Subtle Energies & Energy Medicine Journal Archives*, 2(1).
12. Brandt, E. H. (2001). Acoustic physics: Suspended by sound. Nature, 413(6855), 474-475.

13. Brovetto, P., & Maxia, V. (2008). Entropy Increase in Vacuum: A Conjecture About the Mechanism of Poltergeist Phenomenon. *NeuroQuantology*, 6(2).
14. Campbell, F., & Murray, C. D. (2007). Poltergeists as external representations of a mental state. *Proceedings of Presented Papers: The Parapsychological Association 50th Annual Convention* (pp. 188–191). Petaluma, CA: Parapsychological Association, Inc.
15. Carroll. R. (2011). *The Skeptic's Dictionary: A Collection of Strange Beliefs, Amusing Deceptions, and Dangerous Delusions*. John Wiley & Sons. 374.
16. Charpak, G & Broch, H. (2004).*Debunked! ESP, telekinesis and other pseudoscience*. Transl. by B. Holland, John Hopkins University Press.
17. Cornell, A. D., & Gauld, A. (1961). The geophysical theory of poltergeists. *Journal of the Society for Psychical Research*, 41, 129-155.
18. Carrington, H. (1909). *Eusapia Palladino and Her Phenomena*. New York: B. W. Dodge
19. Carrington, H. (1920). *The Physical Phenomena of Spiritualism Fraudulent and Genuine*. New York: Dodd, Mead & Co.
20. Carrington, H. (1921). Vital energy and psychical phenomena. *Psychic Research Quarterly*, 1, 271-277.
21. Chen S., Xu K. & Lee C. (2012). The dynamic mechanism of a moving Crookes radiometer. Physics of Fluids (1994-present), 24(11), 111701.
22. Colvin, B. G. (2010). The Acoustic Properties of Unexplained Rapping Sounds. *Journal of the Society for Psychical Research*, 74(899), 65.
23. Cox, W. E. (1961). Introductory comparative analysis of some poltergeist cases. *Journal of the American Society for Psychical Research*, 55, 47-72.
24. Crawford W. J. (1921).*The Psychic Structures of the Goligher Circle*, London: John M. Watkins, 145-147.
25. Crookes, W. (1871). Experimental investigation of a new force. *Scientific American*, 25(7), 99-100.
26. Crookes. W. (1872). *Psychic force and modern spiritualism: a reply to the quarterly review and other critics*. London: Longman, Green, Pamphlet.
27. Crookes, W (1874). *Phil. Trans. Roy. Soc. London*, 164, 501.
28. Crookes, W (1875). *Phil. Trans. Roy. Soc.Ondon*, 165, 519.
29. Crookes, W (1876). *Phil. Trans. Roy. Soc.Ondon*, 166, 325.
30. Doyle, A. C. (1926), *History of Spiritualism*, vols. I and II.
31. Edwards, H. (1940), *The Mediumship of Jack Webber*, London: Rider & Co.
32. Einstein A. (1924). *Z. Phys*. 27, 1.
33. Fay, R. D. (1940). Attenuation of sound in tubes. *The Journal of the Acoustical Society of America*, 12(1), 62-67.
34. Ferreira J. M. H. (2004). O radiômetro e as investigações de William Crookes sobre fenômenos espiritualistas. In: Martins, R. A, Martins, L. A. C. P., Silva C. C. & Ferreira J. M. H. (eds). *Filosofia e História da ciência no cone sul: 3o Encontro*. Campinas, AFHIC, p. 257-266.
35. Gaither Pratt J & Keil H. H. J. (1973). First-hand Observations of Nina S. Kulagina Suggestive of PK Upon Static Objects, Parapsychological Association Convention, Charlottesville, Virginia.
36. Haraldsson, E, & Wiseman, R. (1996). Two investigations of ostensible macro-PK in India. *Journal of the Society for Psychical Research*, **61**(843), 109-113.
37. Hashimoto, Y., Koike, Y., & Ueha, S. (1998). Transporting objects without contact using flexural traveling waves. *The Journal of the Acoustical Society of America*, 103(6), 3230-3233.
38. Haynie, D. T. (2001). *Biological thermodynamics*. Cambridge University Press.
39. Hyslop, J. H. (1918), *Life after death*, New York.
40. Ibison, M (2000). An acceptance-rejection theory of statistical phsychokinesis. *Journal of Parapsychology*, 64, 165.
41. Jahn, R. G & Dunne, B. J. (1986). On the quantum mechanics of consciousness with applications to anomalous phenomena. *Foundations of Physics*, 16(8), 721-772.
42. Josephson, B. (1975). Possible connections between psychic phenomena and quantum mechanics. *New Horizons*, 224-226.
43. Kaivarainen, A. (2003). New Hierarchic theory of water and its role in biosystems. The quantum Psi problem. In: *Energy and Information Transfer in Biological Systems: How Physics Could Enrich Biological Understanding: Proceedings of the International Workshop*, Acireale, Catania, Italy, 18-22 September 2002 (p. 82). World Scientific.
44. Keil, J. and Pratt, J. G. (1973). First Hand Observations of Nina S. Kulagina Suggestive of PK on Static Objects. *Journal of the American Society for Psychical Research*, 67, 381-390.
45. Kellogg, O. D. (2012). *Foundations of potential theory (Vol. 31)*. Springer Science & Business Media.
46. Launceston Examiner (1899); Mr Crookes's New "Psychic" Force. (1871, October 3). L (Tas. : 1842 - 1899), p. 3. Retrieved June 26, 2015, from http://nla.gov.au/nla.news-article39684039
47. Luckhurst, R. (2002). The Invention of Telepathy, 1870-1901. Oxford University Press.
48. Maxwell J. C (1879). On stresses in rarefied gases arising from inequalities of temperature, *Philos. Trans. R. Soc. London*, 170, p. 231-256;
49. Nicolis, G., & Prigogine, I. (1977). *Self-organization in nonequilibrium systems* (Vol. 191977). Wiley, New York.
50. Owen A. R. G.(1964), Can We Explain the Poltergeist?, New York: Garrett.
51. Oppenheim, J. (1986).Physics and psychic research in Victorian and Edwardian England, *Physics Today*, 39(5), 62-70.
52. Owen, A. R. G. (1974). A Preliminary Report on Matthew Manning's Physical Phenomena, *New Horizons*, 1(4), 172-3.
53. Passian A., Warmack R. J., Ferrell T. L. & Thundat T. (2003). Thermal transpiration at the microscale: a Crookes cantilever. *Physical Review Letters*, 90(12), 124503.
54. Price, H. (1945). Poltergeist Over England: Three Centuries of Mischievous Ghosts. London: Country Life Ltd.
55. Puskin, V. N. (1976). The antigravity hypothesis as a possible explanation for psychokinetic phenomena, *J. Amer. Soc. Psychosomatic Dentistry and Medicine*, 23(2), 64-68.
56. Radin, D. I. & Nelson, R. D. (1989). Evidence for consciousness-related anomalies in random physical systems. *Foundations of Physics*, 19(12), 1499-1514.
57. Radin, D. I., & Rebman, J. M. (1996). Are phantasms fact or fantasy? A preliminary investigation of apparitions evoked in the laboratory. *Journal of the Society for Psychical Research*, 61, 65-87.
58. Reif, F. (2008). Fundamentals of Statistical and Thermal Physics. Waveland Press Inc.
59. Richards, J. T. (1982). Sorrat: A History of the Neihardt Psychokinesis Experiments, 1961-1981. Scarecrow Press.
60. Rhine, L. E. (1963). Spontaneous physical effects and the psi process. *Journal of Parapsychology*, 27, 84–122.
61. Rhine, L. E. (1970). Mind over matter: Psychokinesis. Oxford, England: Macmillan.
62. Roll, W. G., & Persinger, M. A. (1998). Poltergeist and nonlocality: Energetic aspects of RSPK. *The Journal of Parapsychology*, 62(2), 118.
63. Scandurra, M., Iacopetti F. & Colona P. (2007). Gas kinetic forces on thin plates in the presence of thermal gradients. Physical Review E, 75(2), 026308.
64. Schrenck-Notzing, B. A. (1920). Phenomena of Materialisation: A Contribution to the investigation of mediumistic teleplastics, London: Kegan Paul, Trench, Trubner & Co., 111.
65. Schwarz, B. E. (1985). K: A presumed case of telekinesis. *International Journal of Psychosomatics*, 32(1), 3-21.
66. Selden N., Ngalande C., Gimelshein S., Muntz E. P., Alexeenko A. & Ketsdever A. (2009). Area and edge effects in radiometric forces. Physical Review E, 79(4), 041201.
67. Stewart, B. (1871). Mr. Crookes on the "Psychic" Force. *Nature*, 4(91), 237.
68. Swanson, W. M. (1961). The Magnus effect: A summary of investigations to date. *Journal of Fluids Engineering*, 83(3), 461-470.
69. Taboas, A. M. & Alvarado, C. S. (1981). Poltergeist agents: A review of recent research trends and conceptualizations. *European Journal of Parapsychology*, 4, 99-110.
70. Tymn, M. E. (2009). Cumulative testimony for the Ectoplasm and Materialization Enigma. *Journal of Spirituality and Paranormal Studies*, 1, 36-65.

71. Vincenti, W. G., & Kruger, C. H. (1965). *Introduction to physical gas dynamics.* New York, Wiley.
72. Wiseman. R. & Haraldsson. E. (1995). Investigating Macro-PK in India: Swami Premananda. *Journal of the Society for Psychical Research*, 60(839), 193-202.
73. Watkins, G. K., & Watkins, A. M. (1973). Apparent psychokinesis on static objects by a "gifted" subject: A laboratory demonstration. *Research in parapsychology*, 132-134.
74. Weaver, R. L., & Pao, Y. H. (1981). Dispersion relations for linear wave propagation in homogeneous and inhomogeneous media. *Journal of Mathematical Physics*, 22(9), 1909-1918.
75. Whitton, J. L. (1975). Qualitative time-domain analysis of acoustic envelopes of psychokinetic table rappings. *New Horizons*, 2(1), 21-24.
76. Williams, B. , Ventola, A. , & Wilson, M.(2008). Temperature in Haunting Experiences: A Basic Primer for Paranormal Enthusiasts. Available over the Internet at: http://www. publicparapsychology.org/.
77. Wiseman, R., Watt, C., Greening, E., Stevens, P., & O'Kefffe, C. (2002). An investigation into the alleged haunting of Hampton Court Palace: Psychological variables and magnetic fields. *Journal of Parapsychology*.
78. Woodruff, A. E. (1968). The radiometer and how it does not work. *The Physics Teacher*, 6(7), 358-363.