Article being reviewed

Title: The physics of the Earth's atmosphere III. Pervective power
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General comments

Molecules in the atmosphere are free to move in any direction after each collision. In your experiment, however, you restrict the direction with your connecting tube. Hence you do not emulate the reality of what happens in the atmosphere.

The transfer of kinetic energy by molecular collision already has a name – it is conduction in a solid or often called diffusion in a gas. The term "convection" technically embraces diffusion and advection. If there is already a state of thermodynamic equilibrium in a planet's troposphere then there is a temperature gradient induced by gravity, just as there is a density gradient. The resulting pressure gradient is just a corollary, because gravity acts on mass, not pressure.

Now, it requires a new source of energy disrupting the thermodynamic equilibrium before there can be any noticeable advection. Basically advection is the same as diffusion, but just accelerated to a level where net molecular movement can be detected. That net movement will be in all accessible directions away from the new source of energy that is disrupting the thermodynamic state. There are still plenty of molecules moving in all directions, but there is a net movement away from the source because the source provides addition kinetic energy that tends to drive the "cooler" molecules away.

Overall, the process is governed by the Second Law of Thermodynamics which states that thermodynamic equilibrium will evolve with a state of maximum attainable entropy. In a gravitational field this means there will be no unbalanced energy potentials, and so the mean sum of kinetic energy and gravitational potential energy will be homogeneous.

Note that when new energy is absorbed in a planet's upper troposphere (such as at dawn on Venus) then it disrupts thermodynamic equilibrium and so there will be some downward heat transfer up the temperature gradient, that is from cooler to warmer regions. This is explained in my book "Why it's not carbon dioxide after all" on Amazon.

However, your whole concept of "pervection" is not some other new process, and the measurements you make (wherein the tube restricts the direction of motion) are fictitious in terms of what happens in a planet's troposphere. In any event, diffusion and advection in particular is quite a fast enough process to bring the troposphere back into line with the expected thermal gradient (at thermodynamic equilibrium) which, as you know, is reduced in magnitude by radiating gases which, by intermolecular radiation, have a temperature levelling effect working against the gravitationally induced gradient.

There is empirical evidence of the gravito-thermal effect in a Ranque-Hilsch vortex tube and also in about 850 experiments carried out by Roderich Graeff who, even though he got his physics wrong in that he multiplied by degrees of freedom, did none-the-less observe temperature gradients in sealed cylinders. So, all in all, pervection is an unnecessary fiction. Everything can be explained (as has been in my book) using mainstream physics.

The most serious mistake you make relates to using the term “convection” to relate to wind. In true adiabatic convection (in physics anyway, if not in climatology) the only kinetic energy is that contained in the degrees of freedom of the molecules. As I explained in my previous review comment, diffusion becomes advection when the net movement becomes detectable. The term “convection” in physics strictly speaking relates only to the adiabatic processes of diffusion and advection. It does not relate to wind of any form. Wind is just wind. But even if you disagree, it is important to distinguish whether what you are describing is adiabatic or not. So please refer to it as wind when the process is no longer adiabatic.

So wind is a different process altogether, with an external energy source that imparts additional translational kinetic energy all in one direction, and that additional KE is not related to temperature. (For example, the air in a plane’s cabin does not get hotter when it starts to move along the runway.) When this happens for wind which has a vertical component (up or down) you no longer get the normal temperature gradient, because the velocity of the wind overpowers the slower diffusion process which is what establishes thermodynamic equilibrium, that equilibrium having homogeneous (PE+KE) and thus a temperature gradient, reduced by up to about a third in some cases (eg high water vapour content) by inter-molecular radiation.

My point is that thermodynamic equilibrium throughout a planet’s troposphere evolves in calm conditions without wind which disturbs it. (The temperature gradient is what we expect to see at thermodynamic equilibrium.) For example, the strong downward winds above the South Pole carry air from near the top of the troposphere straight down to the surface where it spreads out and moves away in the Polar Easterlies. Because the wind velocity is so much faster than kinetic (thermal) energy transfer by molecular collision, there are virtually isothermal conditions throughout the troposphere above the South Pole, rather than thermodynamic equilibrium with its necessary temperature gradient that offsets the gradient in gravitational potential energy, and thus ensures no unbalanced energy potentials – this being a state of maximum entropy as the Second Law of Thermodynamics states will evolve spontaneously. That word spontaneously is important. Wind does not allow such spontaneous redistribution of kinetic (thermal) energy by gravity – simply because there is not sufficient time.

The same happens in the stratosphere, where the rate of energy absorption over-rides the slower diffusion cum advection process. All this is better explained in my book, complete with diagrams.

Now, it seems to me you need to study Kinetic Theory. I can in no way imagine what is happening with individual air molecules in your imaginary “pervection” process. Is there any wind component? You don’t make that clear. If not, why would the molecules just go in one direction? What form is the energy taking that supposedly moves so fast? Why is there a need for fast action anyway? For example, in the nominal Uranus troposphere thermodynamic equilibrium has evolved over the life of the planet and there is thus a near-perfect temperature gradient $-g/Cp$ where Cp is the weighted mean specific heat. (It is not the heat capacity, by the way.) So at the base of the Uranus troposphere (where there is no surface, no direct Solar radiation and no convincing evidence of internal energy generation or long-term cooling off) the temperature is 320K – hotter than Earth, but nearly 30 times further from the Sun. Would you care to explain what is happening on Uranus with your imaginary pervection? You might also explain just precisely how the required energy gets into the Venus surface to raise its temperature by 5 degrees (from about 732K to 737K) over the course of its 4-month-long Venus day.

Regarding the issues relating to the stratosphere and tropopause, the authors seem to think that their (non-adiabatic) rapid “pervection” process is required to attain thermodynamic equilibrium. The Second Law of Thermodynamics makes it quite clear that isolated systems autonomously tend towards thermodynamic equilibrium. This is an adiabatic process. It may not be completed if other factors disturb the process. Non adiabatic processes introducing new energy into the system may decrease entropy. That is not what is needed to attain thermodynamic equilibrium. Look it up in Wikipedia or wherever.

Entropy always increases in adiabatic processes and entropy is a measure of progress towards thermodynamic equilibrium.

In other words, thermodynamic equilibrium is the normal state towards which systems progress adiabatically, but the progress may be disturbed and reversed by the introduction of new energy. Of course the system is no longer isolated if new energy can be introduced, so there is no violation of the Second Law when this happens.

Now, in the lower stratosphere the temperature increases with altitude, which is the exact reverse of what we would expect if there were thermodynamic equilibrium in the stratosphere. The reason there is no such thing is because ever day new energy is added by the Sun and there are too few molecules to dissipate that new energy by radiation and downward convection to the troposphere (as well as radiation to space and upward convection to the mesosphere) and so it never gets to thermodynamic equilibrium in the lower stratosphere. You can think of a valley with water flowing down one hillside (the lower stratosphere) towards the valley. A level lake develops in the valley (the tropopause) but it only fills to a certain point, after which energy starts to flow into the troposphere because otherwise it would disturb the thermodynamic equilibrium state which every planetary troposphere strives to achieve *adiabatically* with its gravitationally induced density gradient and temperature gradient, from which, as a corollary, there is a pressure gradient.

Fortunately wind and weather conditions only disturb the state of thermodynamic equilibrium in the Earth’s troposphere to within tolerable limits, though such mass air movement will cause pressure differences which can lead to wild weather (including hurricanes etc) sometimes.
The Connollys seem to have their concepts the reverse of reality. They think they need winds (or an imaginary “pervection” process) to create the observed temperature gradient, whereas in fact gravity does that and winds (or any non-adiabatic process) disturbs the gradient and thus puts “kinks” in the temperature plot. These kinks level out automatically by convection (mostly diffusion but maybe some slow advection) when the weather conditions become calm again.

Why do you suppose that on a calm night early in the morning hours before dawn there appears to be no further upward advection even though the temperature gradient is still there? This demonstrates that the temperature gradient is the normal expected result as thermodynamic equilibrium is approached. In a gravitational field, as you can read here, thermodynamic equilibrium is not an isothermal state.