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Lev Landau
Fudges the Orbital Math

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Abstract: I closely analyze a text from 1960, showing how the equations are pushed. I then show a simpler and far cleaner derivation, using my unified field equation instead of the Lagrangian. This clears up many things.

A reader sent me a brief message today, informing me that Lev Landau had explained and solved the problem of the ellipse long ago. In response to my paper "Explaining the Ellipse", he sent me to Landau and Lifshitz' 1960 publication *Mechanics*, section 14. This reader didn't tell me how he thought Landau answered all my questions in that paper, or *any* of them, and we will see that he doesn't. I have analyzed Landau's math before, in my paper on Asymptotic Freedom. That is where Landau is most famous. I showed that Landau just pushed the math where he wished it to go, like all his colleagues in the mainstream before and since. Here, Landau is doing a copyjob on previous pushes, all the way back to Lagrange and Laplace, so he doesn't get full credit for them. But since he republishes them, he can't dodge the blame. In fact, as we will see again below it was the republications and "streamlining" of these equations by Landau and Feynman and many other top guys in the 20th century that led to our current situation.

Neither Landau nor Lifshitz is adding anything to the historical treatment, although Landau does at least compress the math into a pretty simple form. This makes it even easier to tear apart, showing that Landau and all before him are just assuming what they are expected to prove or demonstrate.

We start on page 30 of the text, in the section entitled "Motion in a Central Field." To avoid coming into contact with any of the questions I ask in my paper, and to avoid any real mechanics or kinematics, Landau immediately hides in the Lagrangian. This is not beside the point, since I have shown in a series of important papers that the Lagrangian itself was created to hide these problems, and that it is non-mechanical and misdefined to this day. That is to say, the Lagrangian has been pushed to match field numbers, so it works pretty well in many situations; but the terms have never been clearly and logically assigned to field causes. I have shown that both major terms in the Lagrangian have been misassigned, and that these assignments are based on field definitions that actually contradict Newton. Besides contradicting Newton, these field assignments contradict eachother and all logic. The Lagrangian itself is a fudge, so when I see Landau diverting his readers immediately into it, I know he is continuing the fudge. The math of mainstream physics is not an *expression* of the mechanics, it is a *hiding* of the mechanics. I have proved this in hundreds of papers, and only those who refuse to read those papers would not know that.

Landau even admits he is dodging from the first word. His first sentence in this section is:

On reducing the two-body problem to one of the motion of a single body, we arrive at the problem of determining the motion of a single particle in an external field such that its potential energy depends only on the distance r from some fixed point.

What does that mean? It means that Landau admits he isn't expressing the motion as a dynamical outcome of body or field relationships. He isn't doing mechanics at all here, since mechanics would require at least a two-body problem. He is "*reducing* the two-body problem" into a simple "path" equation. In doing so, he doesn't have to explain either the mechanics or the dynamics. If he can provide some math that expresses the circle of motion, he will have bypassed any explanation of the *cause* of that motion. That is precisely what the Lagrangian is. It is a compression or reduction of the previous unsupported math, expressing the motion in the simplest manner. But since the previous math was unsupported and undefined, the Lagrangian is, too.

Landau admits that also. A couple of paragraphs later, he says,

The complete solution of the problem of the motion of a particle in a central field is most simply obtained by starting from the laws of conservation of energy and angular momentum, without writing out the equations of motion themselves.

What he means is that he is bypassing the field mechanics, because there is none. He isn't going to bother you with the equations of motion, because if he showed you the equations of motion, you might notice the big dynamical holes in them. It is much simpler (for him) to divert you immediately into a conservation of energy expression, because then you forget to ask for any real mechanics or physics. If you follow his mathematical shortcut, you will think everything pans out, and you will not notice the huge fudges it takes to do the math that way. Twentieth century physicists taught the gravitational field this way *on purpose*, because it allowed them to sweep all the unsightly messes of the past under the rug.

Despite Landau's care to avoid the failed equations of motion, we can detect one big mess here immediately. He starts his second paragraph with this:

As has already been shown in section 9, the angular momentum of any system relative to the center of such a field is conserved.

But if we consult section 9, we only find math showing conservation of momentum of "any particle undergoing rotation." In other words, in that section, Landau is rotating *the whole system*, and therefore any point in the system will be rotated. This rotation is shown to conserve energy. Yes, of course it does, but that has nothing to do with circular or elliptical motion about a point in the field, as in section 14. In section 9, the particle is just rotating from an external viewpoint; but in section 14, this is not the case. The motion of an orbiter *in* a field is a real field motion, and cannot be expressed as a point-of-view rotation of the entire field.

For instance, say I am parked in space at about the distance of Jupiter, and I see the Earth moving around the Sun in a near-circle. Can that motion be explained as a rotation of the entire system beneath me? No. It isn't that the entire field is rotating relative to me, it is that the Earth is moving around the Sun. We know that because other bodies like Venus and Mercury are also in that system, and they aren't frozen relative to the Earth and Sun. The whole space isn't rotating; bodies are moving *in* the space.

Momentum is conserved in section 9 simply because we are rotating the entire system. But once we go *into* the system and monitor motion from there, we must explain energy conservation by other means. Of course we will still find conservation of energy, and I am not questioning that. But the field mechanics should tell us how and why energy is conserved, not just that it is. Neither Landau nor anyone else before me got around to telling us that.

You see, the Lagrangian works backwards from the conservation of energy theorem, and Landau is admitting that. That is precisely why he starts this section by taking section 9 as given. He tells you we have that conservation as given and we will work back from there. Why is that a cheat? It is a cheat for the reason that all action is a cheat: it is circular. Orbital field math should be showing us mechanically how and why energy is conserved. Instead, historical math has taken energy conservation as given and worked back from there. The question begging couldn't be more brazen. Landau is showing us that energy is conserved and then fitting the math to that. That isn't physics, it is just equation finessing. Physics should come with a physical explanation, and neither Landau nor anyone else before me provided that.

Feynman and most 20th century physicists have been in love with action, and that is because action so beautifully hides these mechanical problems. Feynman trumpeted action for the very reasons I have given above: he loved it because it so simply dropped out of the conservation of energy laws. That is clearly why Landau loves it, too. According to the Lagrangian, a body simply follows the path of energy conservation. But that only looks beautiful until you unwind it. Yes, the math follows the conservation law, but that is because it was written to follow the conservation law. It would be very surprising if it *didn't* fit the conservation law, since it worked back from there. But neither the math nor the field mechanics tell us how or why the body follows that curve. These guys act like conservation of energy is physics all by itself. They act like all questions in celestial mechanics are fully answered by conservation of energy. They aren't. A physical explanation of motion would include a cause of that motion. Field equations should show us how and why the field causes the motions. But what we get from Landau and the rest isn't field mechanics, it is just free-floating math, tied only to the conservation laws. I will show that this explains nothing.

As I have shown in my ellipse paper, given the gravity field as it has come down to us from Newton, Laplace, Lagrange, Einstein, and others, the body *shouldn't* follow the curves it does. We know it does, but the gravity-only model can't tell us *why* it does. Given the old equations of motion, the two halves of the ellipse shouldn't even meet up. The simplified equations look pretty good, and they fool most people, but the full equations are full of obvious holes to this day. Put simply, the Lagrangian doesn't match the field mechanics of Newton, and no one after Newton came up with a more convincing field. Those after Newton simply came up with better math. The Lagrangian fits the real motions of real bodies because it is a better equation than Newton's simpler equations. It has two terms where his (initial one)* only had one, and this happens to help our engineers a lot. But in a gravity-only field, these two terms cannot be logically assigned the way they are. In the Lagrangian, the two terms in the equation are providing a feedback mechanism in the field, where one term resists or balances the other term. That's all good, except that gravity cannot resist itself. Gravity has no internal feedback mechanism. One field cannot balance itself, or explain a conservation law. This is what I mean when I say the field is unsupported, and that there is no mechanics. Yes, the Lagrangian works because it is a pretty good unified field equation, but it cannot work as a single-field equation. It cannot work with the terms defined as they are now defined. The math mostly works, but the physics does not. When the math works and the physics does not, the math is fudged. Math should express the field mechanics, but the Lagrangian does not express any known field mechanics. The Lagrangian only matches data. Feynman and the rest have sold such matches to data as a thing of beauty, but they were lying. When heuristic math like this hides big holes in the mechanics and in the field, it is not beautiful. It is very ugly indeed.

We can't easily see this in Landau's "proof", only because he chooses the very simplest example. But if we add any complexity to the field, we find objects doing things for no reason. For example, if we take the C-orbits asteroids that made headlines in 2011, we find the asteroids coming up to the Earth and making a U-turn. Now, the Lagrangian can be pushed to make this look like it is conserving energy, but the problem is any other motion would also conserve energy in the same way, and current physics doesn't tell you why the C-orbit asteroid chooses the motion it does. If the C-orbit asteroid continued on straight ahead and crashed into the Earth, that would also conserve energy in the gravitational field, and we could write a Lagrangian to prove it. It would actually conserve energy in a much more logical fashion than the known motion, since we wouldn't have to leave the cause of one term in the Lagrangian hanging, as we now do. Currently, we let one term in the Lagrangian represent a force that turns the asteroid, but since gravity has no way of explaining that force, the conserved energy is a mystery. The field somehow conserves energy by turning the asteroid, but we don't know how. Physicists just hide behind the Lagrangian and hope you don't ask that question.

From this example, we can see that the whole conservation of energy argument is a diversion. Yes, the circular or elliptical orbit conserves energy, but so would *any other path*, given the right velocity. Given Landau's definitions in sections 9-14, any possible path the particle could take would conserve energy. Only the velocities would have to change. Using his equation 9.3:

$$M \equiv \Sigma rXp$$

[where M is angular momentum] M can be conserved at any r by varying p. Since p=mv, we just have to let v vary, and we can conserve energy along any possible line of motion. The question then becomes, how does the field or particle choose one velocity or path over the other. The Lagrangian can't tell us that. Current physicists can't tell us that.

To explain why the orbit is chosen over all other possible paths requires more than math. It requires more than just the conservation of energy theorem. And it requires more than just the gravitational field. With only the gravitational field, our C-orbit asteroid would *have* to crash into the Earth. It *couldn't* conserve energy any other way, **because the gravitational field is the source of all energy in the field**. If the gravitational field is the source of all energy in the field, we can't have asteroids approaching larger bodies and then turning around for no reason. Why? *Because that would contradict the definition of gravity.*

What is required to explain the Lagrangian and the way it works in real life is a second field. I have shown that the Lagrangian is actually a unified field equation, and that *both* terms in the Lagrangian contain *both* fields. Newton's gravity equation was unified to start with, and since both terms in the Lagrangian are derived either from kinetic or potential energy, they both come from Newton's field. Currently, one term in the Lagrangian is called the kinetic term and one is called the potential, but those assignments are wrong. As I have shown, the potential term in the Lagrangian stands for Newton's gravity equation, and this is pretty much admitted, since they both are written in the same way. But the second term in the Lagrangian is not a kinetic energy term. The field written as potential already implies kinetic energy, so we don't need two terms expressing the same thing. What they call the kinetic energy term is actually a field correction to the other term, variously either expressing the drag the field has on itself, or expressing the feedback mechanism with a finer precision. I have proved this by comparing the Lagrangian to my own unified field equation, derived independently. The Lagrangian is not what we have been told it is.

Some will not understand what I mean when I say that a field written as potential already implies kinetic energy, so let me expand on that briefly, to clarify. These princes of action like Feynman and Landau taught their students that potential and kinetic energy were separate in the field and separable in the equations, but they aren't. Any field of potential is a source of kinetic energy, since any object that is free to move in that field of potential will develop kinetic energy after time zero. According to the field definitions of Newton—and according to all logic—kinetic energy and potential energy are just two ways of expressing the same thing. They are not two separate fields, they are two expressions of *the same field*. Since the gravity field is all that exists in the orbital math, kinetic energy and potential energy must be two expressions of the gravity field. But you can't add the field to itself in a field equation. By the same token, you can't subtract the field from itself.

As a gravity-only field equation, the Lagrangian makes no possible sense. Currently and historically, both terms in the Lagrangian represent the gravity field. Specifically, they both represent *energies* caused by the gravity field. But it is simply not allowed to express the same field energy twice in the same equation. You can't subtract gravitational energy from gravitational energy in a field equation.

To work as well as it does, the Lagrangian must contain a second field. I have proved that field is the charge field—the same field that drives the quantum level equations. The same thing that creates the pluses and minuses on charged particles exists in the Lagrangian as the second fundamental field. This is why the Lagrangian works, why it is able to create a feedback mechanism and a balance, and why the Lagrangian is unified. It is also why the Lagrangian works in quantum mechanics as well as celestial mechanics. The field is unified at all levels.

As for the rest of Landau's proof, it is fudged as well, in even worse ways. He assumes that the angular momentum of a single particle is M = rp, but I have shown that is false. It is the historical equation, yes, but it had been corrupted by previous bad assumptions, including the assumption that the tangential velocity and orbital velocity are the same at the limit. This is another disastrous outcome of

Newton's lemma VI from the *Principia*, where he found the arc approaching the tangent at the limit. Since I have destroyed that proof, many things have been affected, and this angular momentum equation is just one of them. The arc does not approach the tangent, which means the tangential velocity and orbital velocity are not the same at the limit, which means Landau can't use p in this angular equation. Since p=mv and v must be a tangential or straight vector, the variable v cannot be imported into an angular equation. Notice that the equation M = rp implies you can just multiply a linear momentum by a radius to find an angular momentum. That makes no sense. Circular motion isn't linear by definition. It must planar or two-dimensional at the least. But there aren't enough vectors in rp to describe circular motion. The only vector is in the variable v, and it is linear. To fudge this, the historical math tries to vectorize the radius, but the radius is a simple distance, not a vector. For example, in strictly circular motion, the radius would be constant. There would be no change in r at all, as a matter of number. If r isn't changing as a matter of length, you can't vectorize it. The change is only in the angle, but rp doesn't contain the angle, or any way of making that angle into a description of 2D motion.

Newton's error isn't the only one Landau is repeating in this proof. He is also repeating the error in the Virial derivation, started by Lagrange and solidified by Clausius, of taking the derivative of constants. See my papers on the Virial and on the equation $a=v^2/r$ for more on this. To gloss it, just notice Landau is using a dotted r in his equations, which is the derivative or velocity of the radius. What is the velocity of the radius? Say we are in a case of circular motion, where r is constant. How does the radius have a velocity? Isn't Landau expressing the derivative of a constant? I will be told that the radius has *angular* velocity, but how exactly does a dotted r express the radial velocity of a length? Wouldn't you have to insert some number in that equation for the length r? Say the radius is 5. What is the derivative of 5? What is the velocity of 5? And supposing $\dot{r}$ could be defined in some meaningful way: wouldn't that mean that Landau needs to know the angular velocity of his radius r in order to calculate the angular momentum of his particle? If he knows the angular velocity of r, why is he trying to calculate the angular momentum of a particle? Wouldn't that be circular? Landau's equations have no content, since they depend on circular (question begging) assumptions and givens. Landau cannot use this equation to calculate an angular velocity unless he is already given one, so his equation is worthless. Since his equation is circular, his proof fails. He has shown nothing. The truth is, you can't write orbital equations of motion by differentiating a radius, and even Newton knew that. Newton made some mistakes in expressing circular motion, but nothing like this. The audience in Newton's time was too savvy to buy the differentiating of constants.

I will be told that $\dot{r}$ isn't representing the velocity or change in the radius, it is representing the motion of our particle along that radial line. It is the motion of the particle we are differentiating, not the radius itself. That seems to work with the ellipse, but we can see how it fails with the circle. You are being told that because r is changing in the ellipse, as our particle orbits it will move up or down that radial line. The variable $\dot{r}$ then represents that changing distance. We can see this is what Landau intends by going up to his section 4, especially equation 4.5 which he references in section 14. There, he shows that his polar coordinates are just a variation of linear coordinates, where $\dot{x}$ stands for the velocity of our particle in the x dimension. Therefore, $\dot{r}$ must stand for the velocity of our particle in the r dimension. But again, given *circular* (not elliptical) motion, our particle has no velocity in the r dimension, so tracking that velocity as time passes will not help us write an equation for its motion. So in circular motion, Landau's equation for the Lagrangian

Eq. 14.1 $\quad L = \frac{1}{2} m(\dot{r}^2 + r^2\omega^2) - U(r)$

reduces to $\quad L = \frac{1}{2} mr^2\omega^2 - U(r)$ [where ω is the angular velocity: I had no *phi* dot on my keyboard]

But this is still a problem, since polar coordinates aren't written that way. Landau has given us some strange mixture of polar and Cartesian coordinates. To express a position in polar coordinates, you use r and an angle. You can then transfer that to Cartesian coordinates by using sines and cosines. But no position in polar or Cartesian coordinates is represented by rφ. The second position would either be indicated by φ or rsinφ, but never by rφ.

To get what I am driving at, you really have to go back to Landau's derivation of the Lagrangian in section 4. Given rectilinear motion in 3D, Landau uses the Pythagorean theorem to find that

$s^2 = x^2 + y^2 + z^2$

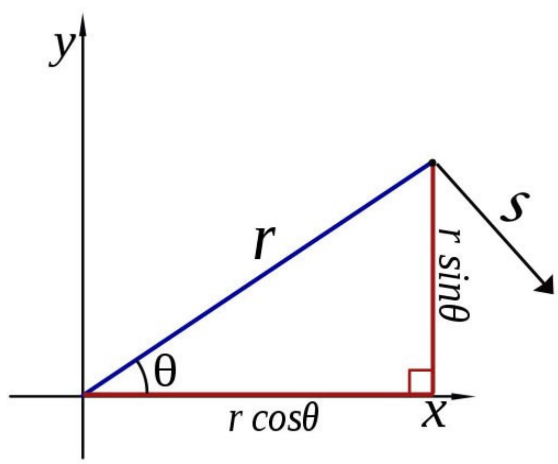
Since v = s/t, we get

$v^2 = \dot{x}^2 + \dot{y}^2 + z^2$

So Landau does the same thing for circular motion. We are told that in polar coordinates

$ds^2 = dr^2 + r^2d\varphi^2$

But is that even true? No. It is a hash. Even if we could use the Pythagorean theorem on curves at the limit, that equation would still be a hash. Why? Because s isn't the hypotenuse of r and rφ.

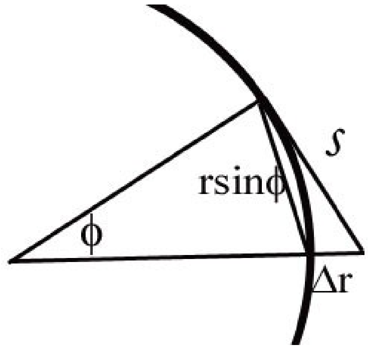


If our body is moving in a polar coordinate system along some infinitesimal vector s, that distance s cannot be expressed by using the Pythagorean theorem on r and rφ. Landau admits that s is at right angles to r [“M is perpendicular to r,” p. 30], so how is s possibly going to be expressed this way:

$s = \sqrt{[r^2 + (r\varphi)^2]}$

Even if the length rφ existed (it doesn't—you can't multiply a length by a raw angle), the Pythagorean theorem doesn't work that way. It only works when s is the hypotenuse of the other two legs, and those two legs have to be orthogonal. Since s is orthogonal to r, s can't be the hypotenuse of any triangle r is in.

Let's look at a different diagram, to see if this can be explained sensibly:



What if we assign the variables this way, and then let that little triangle to the right go to a limit? If we let φ be very small, then the angle at Δr will be almost 90, and we can apply the Pythagorean theorem. In that case *s* looks more like a hypotenuse. But we still have many problems. One, if we go to a limit, Δr goes to zero. An even worse problem is encountered when we notice that Δr is already a sort of ṙ. It certainly isn't an r. Therefore, if we follow Landau's math, we encounter a major snafu.

$s^2 = \dot{r}^2 + (r\sin\varphi)^2$

But we still need to turn *s* into a velocity, to get it into the Lagrangian. Since v = *s*/t,

$v^2 = [\dot{r}^2/t^2] + [(r\sin\varphi)^2/t^2]$

As you see, we have problems in both terms, because the first term can't now be written as $\dot{r}^2$. If anything, we would have to write it as r double dot. The second term has an equally large problem, since even if we dump the sin for some reason, the dot would have to go over rφ, not just φ. If we put the dot over rφ, we don't get an angular velocity ω.

$\omega \neq d(r\sin\varphi)/dt$

I almost hate to write it that way, for fear someone will say, "Oh, sure it is, thanks! We'll use that." Fortunately, they can't borrow it from me, since it doesn't fit Landau's proof. Remember, Landau needs both r^2 and ω^2 in his second polar coordinate, as in eq. 14.1. Borrowing that last equation from me would give him only the ω^2. That is why he makes sure to separate out r and ω, though he has to break rules to do it.

No matter how we diagram this motion, it doesn't work.

As further proof it doesn't work, you may consider that the second diagram contradicts Newton's lemma VI. All of modern calculus and trigonometry rests on lemma VI, so Landau is certainly not intending to overturn it here. But lemma VI proves that at the limit, the arc and the chord go to equality. This is what allows Newton to prove that the tangential velocity becomes equivalent to the orbital velocity at the limit, which is where we get M = mvr = pr, among many other things (see above). But if we try to make *s* into a hypotenuse, we have contradicted all that. Why? Because Newton's lemma VI tells us *s* and rsinφ are equal at the limit, ruining everything. If *s* and rsinφ are equal at the limit, Landau's polar coordinates are blown. Landau needs lemma VI to get M = pr (eq. 9.3), but he has to ignore it to get his polar coordinate Lagrangian, as we have just seen.

This means that Landau's polar expressions of the field are pushed. Both equations 4.6 and 14.1 are horrible fudges. The equations are worse than fudges, since fudges can be pushed to match data. This equation above is just false. It can't possibly match any data, short of a miracle.

Landau seems to recognize that as well, since he tries to weasel out of equation 14.1 as soon as it hits the page. He says,

This function does not include the coordinate [*phi* dot] explicitly. Any generalized coordinate q_i which does not appear explicitly in the Lagrangian is said to be cyclic. [Etc.]

But his equation 14.1 *does* include the coordinate *phi* dot explicitly.

Eq. 14.1 $L = ½ m(\dot{r}^2 + r^2$**[*phi* dot]**$^2) – U(r)$

It's *in* the equation: how much more explicit could it be? And it isn't even a coordinate. A coordinate is a position in a field. The variable *phi* dot is not a coordinate, it is a velocity. A velocity is not a coordinate. But we see why Landau is trying to weasel out of it. Not only does his squared expression not work, his *phi* dot doesn't work either. This is because in polar coordinates, *phi* is defined as the angle from some given zero line. But once you put it next to r—as in rsinφ—it is no longer an angle. It is then a distance in y, as in the first diagram above. So not only does Landau have a mixed polar/Cartesian expression—using both r and rφ—he is also trying to keep *phi* dot as an angular velocity, even after he has joined it to r. He can't do that. Once φ is joined to r, it becomes a distance in y, and if anything then has a velocity or change, it is that distance in y, not the original angle. Landau is trying to separate out r and φ, squaring them separately, but you now understand that they should be written $(r\sin\varphi)^2$, not $r^2\varphi^2$. And if Landau wants to express some change in that distance, he would have to put the dot over the whole expression rsinφ, not just the angle.

This is why Landau wrote the second polar coordinate as rφ instead of rsinφ. He is fooling you *on purpose*. These guys don't just accidentally pour this fudge on your head because they don't know any better. They are snowing you and trying their best to disguise it so you don't see it. Just as I showed Feynman doing in his “proof” of $a=v^2/r$, Landau is writing terms with raw angles in them. This allows both Feynman and Landau to do things illegally, but to cloak their pushes. These Nobel Prize winners are masters of this sort of manipulation. As we have seen, Nobel Prize winners have no problem fudging the Pythagorean theorem or simple coordinates, and they are so clever they can pass this fudge by most readers. How many people have caught them at it over the years?

To hide all this garbage, Landau immediately replaces φ dot with M/mr^2, obtaining equation 14.4. He was pushing his variables into that form just so he could do that, you see. He had to keep that r^2 in his second polar coordinate intact, because he knew he needed it. We just saw him break several basic mathematical rules in order to keep r separate from φ in that expression, but we now see why he had to do it. He had to express his second polar coordinate as a non-polar pseudo-Cartesian coordinate, he had to write it without the sin, and he had to dot the angle but not the radius. Three broken rules in one term. Wow.

But once he inserts M into the equations, all his finesses are gone. After that you aren't tempted to ask any questions about φ dot, because you are now trying to figure out what he is doing with his differentiation and integration in equations 14.5 and 14.6. But since his equations have been compromised in every single line, by one fudge or another, every single line after his first one is false.

They are all wrong in multiple ways, and are now just bombast to fill up the pages in the book.

We can see how confused Landau is by studying his commentary after equation 14.9. He says,

When equation 14.9 is satisfied, the radial velocity $\dot{r}$ is zero. This does not mean the particle comes to rest, since the angular velocity is not zero. The value $\dot{r} = 0$ indicates a turning point of the path, where r(t) begins to increase instead of decrease, or vice versa.

But that means we must be in ellipse in equation 14.9, since only ellipses have these turning points. In a circle, r(t) is a constant, so there are no turning points. If $\dot{r} = 0$ is an ellipse, what does $\dot{r}$ equal in a circle? Since the radius r is not changing in a circle, $\dot{r} = 0$ should indicate a circle, not an ellipse. But then how would we differentiate a circle from an ellipse, if not with a changing r? Since r is changing in an ellipse, $\dot{r}$ *should* indicate that change, which means $\dot{r} \neq 0$ in an ellipse. Not only can no one else make kinematic or mechanical sense out of Landau's math, he can't make sense out of it either. He is just as lost as you are.

You see, Landau has to define $\dot{r}$ as a turning point in the ellipse, because he can't define it in any normal way. If he defines it as either the velocity of r or the change in r, his equations falls apart. The variable $\dot{r}$ can't be a velocity, because the radius is a length and a length can't have a velocity. Only things at positions in the field can have velocities. And $\dot{r}$ can't be a change-in-r, either, because Landau needs to differentiate r in order to solve for motion in his field. Since you can't differentiate a constant, he could find no motion in a circular field with these equations. If $\dot{r}$ is really zero, you can't find a derivative, r can no longer be fudged into a vector, and letting time pass will give you no angular velocity (unless you are already given one).

I don't have any more time to waste with this, but I will tell you that Landau's problems aren't limited to sections 4, 9 and 14. I scanned some of the other sections, and every one is nothing more than a series of finesses and cloaks. Modern physicists will plop down any equation that suits them, knowing their readers won't question it. All of contemporary physics has become little more than an extended mathematical finesse, poorly hidden. If Nobel Prize winners will fake a Pythagorean theorem right in front of your face, do you think they are more honest when it comes to quantum equations?

So how can we correct this? Let's start by going back and dumping the polar coordinates entirely. We can then express the velocity in the Lagrangian by using equations I derived in my $a=v^2/r$ paper.

$$v^2 = a^2 + 2ar$$

This equation serves to remind us that the momentum of an orbiter cannot be determined without knowing the centripetal acceleration *a*. Note that Landau tried to write the equations without including any mention of *a*. He told us the potential energy was completely dependent on r (see first Landau quote above). But it isn't. That is true only if you are given a single value for *a* and are calculating different energies for different r's in that one field. But Landau is presenting us with a *general* equation to fit in a generalized Lagrangian, which should apply to any circular or orbital motion in any "central" field whatever. The same particle at the same r will not have either the same potential energy or the same angular momentum in fields with different values for *a*. So there is no possible way to write a generalized Lagrangian for a central field without including *a*. Newton recognized this, because all his orbital math contains *a*. But later mathematicians found that requirement limiting, and found ways around it, as we have seen. Landau tries to replace *a* with $\dot{r}$, but I have shown how that fails. This also confirms my previous analysis, since I showed that he really needs something like r double dot, which would be an acceleration. This also solves the problem of the circle, since although $\dot{r}$ goes to zero with circular motion, *a* doesn't. My correction allows us to solve for both ellipses and circles.

Some will say, "No, potential energy is dependent only on r, not on *a*." But we can see that is false just by looking at the limiting case where the particle has no orbital velocity. Say we drop a particle from radius r in two fields, one with an *a* of 1 and one with an *a* of 2. As our particle falls, it will develop more speed in the second field, and when it crashes into the central body, it will have more momentum. If it had more momentum, it must have had more potential energy at r.

I will be told that the tangential motion balances that out, since as the centripetal potential energy rises the tangential potential energy falls. But we know the opposite is true. If the Sun suddenly gained mass, *a* would increase and the Earth would have to increase its tangential speed or its would begin falling into the Sun. *Both* the Earth's centripetal potential energy and its tangential potential energy would increase. There would be no balance, there would be a doubled rise. This proves that neither potential energy nor angular momentum are dependent on r alone. The equations must include *a.*

But we still haven't made all the necessary corrections. I have shown that the Lagrangian is trying to mimic my unified field equation, and to solve this, we need to simply replace the flawed Lagrangian with my UFE:

$E = (GmM/r) – 2mar^2/ct$

I derived that equation independently of the Lagrangian and all historical math, as you will see in my paper on the UFT. If we dump the relativity transform my UFE already includes, we are down to this:

$E = (GmM/r) – 2mar$

If we let $a = v^2/r$, and write the equation to match the form of the Lagrangian, that becomes

$L = U(r) – 2mv^2$

Which is very close to the current Lagrangian. My terms are reversed, but the equation is otherwise very similar, as you see. However, I have shown that the equation $a = v^2/r$ is not correct, so we have to do a bit of fixing here. If we instead substitute my equation for v^2 into that one, we can get a velocity into it legally.

$L = U(r) – 2mr [\sqrt{(v^2 + r^2)} - r]$

That v is a straight-line tangential velocity, not an orbital or angular velocity. Now, to correct Landau's final equations, we need to write that in terms of the angular momentum M, as he does. Since I have also corrected that equation, we need my new equation M = mω.

$L = U(r) – 2Mar/\omega$
$a = \omega^2/2r$

$ar = \omega^2/2$
$L = U(r) \; - \; 2M\omega^2/2\omega$
$L = U(r) \; - \; M\omega$
$L = U(r) \; - \; M^2/m$

Since Landau finds a total effective potential, he adds those terms rather than subtracts them, giving us

$$\mathbf{E = U(r) \; + \; M^2/m}$$

Compare that to Landau's equation 14.8:

$$E = U(r) \; + \; M^2/2mr^2$$

I have just provided you with a simplification at the same that I provided a correction. Although my final equation is simpler, it includes the variance in a, whereas the current Lagrangian doesn't. You can see the historical equations were being pushed back to my equations, but they weren't pushed quite far enough. The correct equations are both more complex in derivation (since they contain the variance in a) and more simple in final form (since although we have some of the same variables at the same levels, we don't have the radius squared). The old and new equations resolve, however, since although we lose the square radius in the denominator, we have a different number for M as well. Using the old equations was giving them a number too large for the angular momentum. The current equation for angular momentum is $M = mr^2\omega$, which, as you can see, is too large by precisely r squared. The current equation also has an extra 2 in it, and that comes from the same set of mistakes, going all the way back to Newton's proof of $a=v^2/r$.

I encourage you to notice how much quicker and more transparent my proof is than Landau's. I don't divert you into any polar coordinates or integrals, and I don't finesse you at any point. I also encourage you to notice again that my unified field equation matches the Lagrangian here almost exactly. If I didn't correct Landau's M equation, I would get the same answer Landau does, except for that two (which comes from the same correction). This should astonish you as much as anything, since although I have shown how to go from my unified field equation to the Lagrangian in a couple of previous papers—including my paper on Schrodinger's Equation and my original paper on Unlocking the Lagrangian—my explanations become clearer with each new paper I write. The reason this should astonish you is not only that my UFE is unified and matches the Lagrangian, but even more that I was able to derive this equation without starting from the Virial, without starting from circular motion, and without starting from any of the historical assumptions that led to the Lagrangian. I derived my UFE completely independently from the historical line of reasoning, starting over from first postulates. You can confirm this by re-reading what you should have already read: my first UFT paper, where I show the entire derivation. Some have avoided that paper due to its length, but none of it is difficult. The first part is just history, and the important central part is simple math. The paper, though somewhat long, is far easier to penetrate than the papers of any of the old guys I am correcting—which you can also confirm by reading their original derivations of the Lagrangian.

*Newton later almost came up with the Lagrangian himself, but they never tell you that.