1.) Notes for Paper 115.

115(1): Generalization of the Theorem of Orbits

The Frobenius Theorem applied to spherically symmetric spacetime produces the line element:

$$ds^2 = -n(r)\, c^2 dt^2 + m(r)\, dr^2 + r^2 d\Omega^2 \quad -(1)$$

in spherical polar coordinates. For the vast majority of orbits:

$$nr = \frac{r}{m} = \int dr \quad -(2)$$

where:

$$\int dr = r + \mu \quad -(3)$$

where μ is the constant of integration. Therefore:

$$n = \frac{1}{m} = 1 + \frac{\mu}{r}. \quad -(4)$$

The Frobenius Theorem states that eq. (1) is the line element of a static and spherically symmetric spacetime and the theorem of orbits defines n and m. By experimental observation:

$$\boxed{\mu = -\frac{2MG}{c^2}} \quad -(5)$$

where M is the mass of a gravitating object, G is the Newton constant and c the vacuum speed of light. Eq. (5) is therefore the link between geometry and physics. The Frobenius Theorem and the Theorem of Orbits are pure

2) geometry.

In binary pulsar systems it is claimed that there is a decrease of a few millimetres per ~~year~~ orbit. In order to describe this the theorem of orbits must be developed so the integrand in eq. (2) is no longer unity, i.e.:

$$\boxed{nr = \frac{r}{m} = \int f(r)\, dr} \quad - (6)$$

and this is a more general form of the theorem of orbits.

<u>For binary</u> pulsars:

$$\boxed{f(r) = 1 + \frac{a}{r^2}} \quad - (7)$$

so:

$$nr = \frac{r}{m} = r + \mu - \frac{a}{r} \quad - (8)$$

i.e., experimentally:

$$\boxed{n = \frac{1}{m} = 1 - \left(\frac{2MG}{c^2 r} + \frac{a}{r^2} \right)} \quad - (9)$$

This line element produces a relativistic orbit that spirals inwards as in paper 108. The relativistic orbit is observed to be eccentric with a perihelion advance of a few degrees per orbit. The very tiny perturbation a in eq. (7) causes the orbit to spiral inwards as observed.

3)

Discussion

If a symmetric connection:

$$\Gamma^{\kappa}_{\mu\nu} = \Gamma^{\kappa}_{\nu\mu} \quad - (10)$$

is assumed, it has been shown in paper 111 that a line element defined by (9) violates the Hodge dual of the Bianchi identity if the Einstein field equation is also assumed. This is another example of the by now familiar failure of the Einstein field equation. The latter is not used in the description of orbits as shown in paper 114.

It is interesting to speculate whether the theorem (6) can lead to a generally covariant unified field ~~theory~~ based purely on the spherical symmetry of spacetime. In order to prove this, a link would have to be established between eq. (6) and the Cartan structure equations. The latter are due to the commutator $[D_\mu, D_\nu]$ acting on the four vector V^{κ}.