# Differential geometry, gauge theories, and gravity M. Göckeler and T. Schücker

# Errata in the paperback edition

Equation (2.58)

 $\frac{1}{p!}$  should be replaced by  $\frac{1}{q!}$ .

Equation (3.16)

should be followed by: ", where  $(i_1, \ldots, i_n)$  is a permutation of  $(1, \ldots, n)$ , no summations."

Equation (4.22)

 $\int \mathrm{d}(j \wedge \mathrm{d}\Lambda)$  should be replaced by  $\int \mathrm{d}(j \wedge \Lambda)$ .

Equation (5.27)

The prefactor on the right-hand side should be  $\frac{+1}{16\pi G}$  instead of  $\frac{-1}{32\pi G}$ .

 $\frac{\text{Equation (5.30)}}{\mathscr{L}_{\mathrm{M}}[e+f] - \mathscr{L}_{\mathrm{M}}[e] \text{ should be replaced by } \mathscr{L}_{\mathrm{M}}[e+f,\omega] - \mathscr{L}_{\mathrm{M}}[e,\omega].$ 

 $\frac{\text{Equation (5.41)}}{G_{s}^{k} \text{ should read } G_{c}^{k}}.$ 

 $\frac{\text{Equations (5.43) and (5.46)}}{S_{\text{EH}}[\omega + \chi] - S_{\text{EH}}[\omega] \text{ should be replaced by } S_{\text{EH}}[e, \omega + \chi] - S_{\text{EH}}[e, \omega].$ 

Line before (5.47)

This line should read "We have to give the variation of the matter Lagrangian a name:".

 $\frac{\text{Equation (5.47)}}{\mathscr{L}_{\mathrm{M}}[\omega + \chi] - \mathscr{L}_{\mathrm{M}}[\omega] \text{ should be replaced by } \mathscr{L}_{\mathrm{M}}[e, \omega + \chi] - \mathscr{L}_{\mathrm{M}}[e, \omega].$ 

Page 68

The last sentence of section 5.4 "The field equations which we have derived in an orthonormal frame are covariant and therefore valid in any frame." is correct only for Einstein's equation (5.40), but not for equation (5.48) for the torsion.

#### Page 69

On page 69 two paragraphs are interchanged. Moreover, an index is missing in the unnumbered equation before (5.53) and the ordering of the indices  $\rho$  and  $\sigma$  in  $\Gamma^{\mu}{}_{\rho\sigma}$  is inconsistent with the equation after (5.24). The corrected text should read as follows:

 $\ldots$  is called the 'Riemannian' or 'Levi-Civita' connection of the metric g.

In a holonomic frame  $\beta^{\mu} = dx^{\mu}$  the Cs are all zero and the  $\Gamma^{\mu}{}_{\rho\sigma}$  are called Christoffel symbols. Furthermore,

$$0 = T^{\mu} = \mathrm{dd}x^{\mu} + \Gamma^{\mu}{}_{\sigma\rho}\mathrm{d}x^{\rho} \wedge \mathrm{d}x^{\sigma}$$

implies

$$\Gamma^{\mu}{}_{\rho\sigma} = \Gamma^{\mu}{}_{\sigma\rho} \,. \tag{5.53}$$

We call this a bastard symmetry because it mixes form and value indices.

In an orthonormal frame  $\beta^a = e^a$  the components of the metric are constant and the second part of equation (5.51) vanishes.

The formula for the Riemannian connection is valid in all ...

First lines on page 69 and 71

We leave it to the reader to choose between "view point" and "viewpoint".

#### Page 74

In the last line of the first paragraph "Yan" should be replaced by "Yau".

#### Equation (5.75)

A wedge  $\wedge$  is missing on the right-hand side. The equation should read

$$\mathscr{L}_{\mathcal{M}}[e+f] - \mathscr{L}_{\mathcal{M}}[e] = \frac{1}{g^2} f^c \wedge \left(\frac{1}{4} F^{ab} \epsilon_{abcd} e^d \wedge F - \frac{1}{2} F_{cb} e^b \wedge *|_e F\right)$$

#### Page 116

In the seventh line from the bottom "... which is also a submanifold." should be replaced by "... which is also an embedded submanifold.".

#### Page 108

In the second line of section 7.10 "Replacing  $\mathbb{R}^4$  by the half space" should be replaced by "Replacing  $\mathbb{R}^n$  by the half space".

The line after (8.14)

In this line "homeomorphism" should be replaced by "homomorphism".

One and two lines after (8.20)

In both lines "homeomorphism" should be replaced by "homomorphism".

Three lines after (8.25)

In this line "homeomorphism" should be replaced by "homomorphism".

## Page 123

In the first line of section 8.4 "homeomorphism" should be replaced by "homomorphism".

Equation (8.39)

The last line of this equation should read

$$= -\sum_{i,j,k} \left[ l^i{}_k l'^k{}_j - l'^i{}_k l^k{}_j \right] y^j \frac{\partial}{\partial y^i} \,.$$

#### Page 124

The remark "The minus sign is motivated ..." might lead to the erroneous assumption that the minus sign in the assignment

$$l \mapsto - \left(l^i{}_j\right)$$

could be omitted. Then, however, this is no longer a Lie algebra isomorphism.

#### Equation (8.65)

This equation could be misunderstood without further explanations. Perhaps it would be better to write

$$\varphi_g = \left(T_g L_{g^{-1}}\right)^* \varphi_e$$

for the forms  $\varphi_g$ ,  $\varphi_e$  on the respective tangent spaces.

## Equation (8.78)

This equation should read

$$\zeta^{i_1 i_2}(g) = L_{g^{-1}}^* \zeta^{i_1 i_2}(e) = \sum_l x^{i_1 l}(g^{-1}) \, \mathrm{d} x^{l i_2}|_g \, .$$

# Ninth line after equation (9.16)

"diagram like (9.16):" should be replaced by "diagram like (9.16).".

Page 155

Item (a) after equation (9.134) should read:  $\dot{\tilde{Q}}|_{\tau} \in H_{\tilde{Q}}(\tau)$  for  $\tau \in [0, 1]$ .

Line after equation (10.10)

This line should read "and on  $\mathscr{U}_2 = S^2 - \{(0, 0, 1)\},$ ".

Equation (11.28)

The last line of this equation should read

$$\varphi_u v := uvu^{-1}(-1)^{\operatorname{degree}(u)}.$$

Second line after equation (11.32)

This line should read "respect to the plane orthogonal to u. Therefore ...".

 $\frac{\text{Line after equation (11.33)}}{\text{In this line "for all } n \ge 3."} \text{ should read "for } n \ge 3, r = 0 \text{ and } n \ge 4, r = 1.".$ 

Third line after equation (11.41)

This line should read "has no (finite dimensional) linear representations ....".

Second line before equation (11.43) In this line "Spin(1,1)" should be replaced by " $Spin(1,1)^e$ ".

Second line after equation (11.48) This line should read " $T_{\mathbb{1}}\varphi : spin(r,s) \to so(r,s)$ ".

Page 198

The end of the last line should read " $Spin(r, s)^e \cong SO(r, s)^e$  for r + s = 2."

Page 222

The second reference on this page should read Papapetrou, A. (1949). *Phil. Mag.* **40**, 937.