Classification of Lie groups

Let $\mathfrak{g}$ be a Lie $\mathbb{R}$-algebra. There is an unique simply connected Lie group G with Lie algebra $\mathrm{Lie}(G) \cong \mathfrak{g}$.
The connected Lie groups whose Lie algebras are isomorphic to $\mathfrak{g}$ are precisely

$$\frac{G}{\Gamma}$$

where $\Gamma \lhd G$ is a discrete normal subgroup.
Arbitrary Lie groups Q are extensions of connected Lie groups by discrete Lie groups

$$0 \to Q_0 \hookrightarrow Q \twoheadrightarrow \pi_0(Q) \to 0$$

Theorem 21.32. *Let $\mathfrak{g}$ be a finite-dimensional Lie algebra. The connected Lie groups whose Lie algebras are isomorphic to $\mathfrak{g}$ are (up to isomorphism) precisely those of the form G/Γ, where G is the simply connected Lie group with Lie algebra $\mathfrak{g}$, and Γ is a discrete normal subgroup of G.*

21-22. If G and H are Lie groups, and there exists a surjective Lie group homomorphism from G to H with kernel G_0, we say that G is an ***extension of G_0 by H***. Let $\mathfrak{g}$ be any finite-dimensional Lie algebra, and show that the disconnected Lie groups whose Lie algebras are isomorphic to $\mathfrak{g}$ are precisely the extensions of the connected ones by discrete Lie groups. [Hint: see Proposition 7.15.] (*Used on p. 557.*)