[K] A. Knapp, *Representation theory of semisimple groups*, Princeton Univ. Press, Princeton, New Jersey, 1986.

[S] A. Selberg, *Harmonic analysis and discontinuous groups in weakly symmetric Riemannian spaces with applications to Dirichlet series*, J. Indian Math. Soc. **20** (1956), 47–87.

PAUL B. GARRETT
UNIVERSITY OF MINNESOTA

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Etale cohomology and the Weil conjecture by Eberhard Freitag and Reinhardt Kiehl. Springer-Verlag, Berlin, Heidelberg, New York, 1988, xviii + 317 pp., $98.00. ISBN 3-540-12175-7

It is now some sixteen years since Deligne's spectacular proof [De-Weil I] in June, 1973, of the "Riemann Hypothesis" for zeta functions of projective nonsingular varieties over finite fields completed the overall proof of the Weil Conjectures [We]. For an expository account of all this, see my survey article [Ka].

In the fall of 1973, Deligne formulated and proved [De-Weil II] a far-reaching generalization, which applied to arbitrary varieties over finite fields, and to quite general L-functions on them. It is this generalization, rather than Weil I itself, which has since proven an extremely powerful tool with all sorts of applications, from exponential sums to perverse sheaves.

The book under review is devoted to giving a thorough exposition of Weil I, and of the background material concerning Grothendieck's theory of l-adic cohomology which that paper presupposes. In this the authors succeed admirably. The book does not discuss Weil II at all, except for a two page summary (IV, 5) of some of its main results near the end. Perhaps someday if the authors feel ambitious... .

The excellent 1975 survey article of Dieudonne [Di] on the Weil Conjectures and their solution has been reprinted in the present book as an "historical introduction." Thus the reader has no problem in knowing from the beginning what the "point" of the book is. And if he keeps open a copy of Weil I, which is only 34 pages long, he will not lose his way as he reads through the book. The quality of the exposition is quite high, although the book is (necessarily, being of finite length) not self-contained, and occasionally anachronistic. For instance, on pp. 63–64 Artin approximation (1969) is used in the proof of proper base change (1963). The book also has three quite useful and compact appendices, devoted to fundamental groups, derived categories, and descent respectively.

The book has an unexpectedly large number of typographical errors for a Springer product, but the ones I noticed were easily deciphered. For instance, in (II, 3.3 Lemma, p. 159) the numbers "1)" and "2)" marking the two statements are one and three lines too low respectively. On the following page 160, there is a typo in the last printed line of ordinary text (" $>.>$ " for "3.3, 2)"), and the footnote below contains three typos ("note" for "not", "notation" for "notion", "*a*" for "a"). In (II, 4.2 Proposition, p. 172), we have "stead" for "stated", and on p. 201, line −2 we have "H^2" for "$H^{2\nu}$".

For the serious student of etale cohomology, there is still no substitute for reading the two thousand or so pages of SGA [SGA]. But the present book, like Milne's book *Etale Cohomology* [M] before it, makes the subject more accessible. Indeed, one might wish to keep open one or both of these books in reading SGA. But for the reader who wants "only" to be able to follow the beautiful arguments of Weil I, this book will do very nicely.

REFERENCES

[De-Weil I] P. Deligne, *La conjecture de Weil* I, Publ. Math. Inst. Hautes Études Sci. **48** (1974), 273–308.

[De-Weil II] ——, *La conjecture de Weil* II, Publ. Math. Inst. Hautes Études Sci. **52** (1981), 313–428.

[Di] J. Dieudonne, *On the history of the Weil Conjectures*, The Mathematical Intelligencer **10** (1975).

[SGA] A. Grothendieck et al., *Séminaire de géométrie algébrique du Bois-Marie*, SGA 1, SGA 4 Parts I, II, and III, SGA $4\frac{1}{2}$, SGA 5, SGA 7 Parts I and II, Lecture Notes in Math., vols. 224, 269–270–305, 569, 589, 288–340, 1971 to 1977.

[Ka] N. Katz, *An overview of Deligne's proof of the Riemann hypothesis for varieties over finite fields*, Mathematical Developments arising from Hilbert Problems (F. Browder, ed.), Proc. Sympos. Pure Math., vol. 28, Amer. Math. Soc., Providence, R.I., 1976, pp. 275–306.

[M] J. S. Milne, *Etale cohomology*, Princeton Math. Series 33, Princeton Univ. Press, Princeton, N.J., 1980.

[We] A. Weil, *Number of solutions of equations over finite fields*, Bull. Amer. Math. Soc. **55** (1949), 497–508.

NICHOLAS KATZ
PRINCETON UNIVERSITY