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PARACONSISTENT LOGICS

The driving thought of paraconsistency is that there are situations in which information, or legal, scientific, or philosophical principles (and so on) are inconsistent, but in which people want to draw conclusions in a sensible fashion. Clearly, if one uses a logical consequence relation in which contradictions imply everything—that is, in which $A, \neg A \vdash B$, for all A and B—this is not possible: a person would have to conclude everything (*triviality*). This motivates the definition of a paraconsistent logic. The principle of inference that contradictions entail everything is called *explosion* (or *ex falso quodlibet sequitur*). A paraconsistent logic is one in which explosion is not valid.

Paraconsistent logics are not new. As Aristotle (*An. Pr.* $63^{b}31$–$64^{a}16$) points out, syllogistic is paraconsistent. The idea that explosion is a correct principle of inference seems to have arisen in the twelfth century, with the discovery of the following simple argument. Suppose that $\neg A$; then $\neg A \vee B$. But now suppose that A as well. Then B follows by the disjunctive syllogism ($A, \neg A \vee B \vdash B$). Explosion and the disjunctive syllogism had variable fortunes in later Medieval logic. A common move was to distinguish two notions of validity: one (*material*) for which they held; and one (*formal*) for which they do not. All this was forgotten after the Middle Ages. But since the early twentieth century, the hegemony of Frege/Russell (classical) logic, according to which explosion is valid, has ensured the orthodoxy of the principle.

Modern formal paraconsistent logics started to appear in the second half of the twentieth century. Amongst the earliest paraconsistent logics were those proposed by Stanisław Jaśkowski (1948) and Newton da Costa (1963). The paraconsistent possibilities of the relevant logic of Alan Anderson and Nuel Belnap (1960s) was also soon recognized. By the end of the twentieth century there were many paraconsistent logics with well-defined semantics and proof theories.

In the semantics of most paraconsistent logics, validity is defined in terms of the preservation of truth-in-an-interpretation. It must therefore be possible to have interpretations where A and $\neg A$ are both true. There are several ways of achieving this end. One is to take truth to be truth-at-a-world in a world-semantics for modal logic (as in Jaśkowski's system D_2, "discussive logic"). In this case, the inference of adjunction ($A, B \vdash A \& B$) will fail, giving rise to a nonadjunctive paraconsistent logic. Another possibility is to graft a non-truth-functional negation on to some positive logic (as in the da Costa C-systems). The truth value of $\neg A$ is not determined by that of A; both may then be true. This gives so-called "positive-plus" paraconsistent logics. A third possibility is to employ a many-valued logic in which some designated truth value, v, is a fixed point for negation. That is, if the value of A is v, the value of $\neg A$ is also v. v may be the value *both true and false*, as in Graham Priest's *LP*, or the value 0.5 where the semantics has the real numbers between 0 and 1 as truth values. The way that negation is handled in relevant logic also has the same effect.

In nearly all paraconsistent logics, there are ways of recapturing the full force of classical reasoning. Thus, in discursive logic, if the premises are conjoined then they have all of their classical consequences. Da Costa suggested augmenting the language with an operator, °, such that, intuitively, $A°$ expresses the consistency of A. The classical negation of A can then be expressed by $\neg A \& A°$. A different way was suggested by Diderik Batens. Consistency-ordering is defined on interpretations, such that classical interpretations (and only those) come out as the most consistent. A notion of validity is then defined according to which an inference is valid iff (meaning "if and only if") the conclusion holds in all those interpretations which are as consistent as possible, given only that the premises hold in them. This gives a nonmonotonic notion of consequence according to which the consequences of a consistent set of sentences are just their classical consequences. (Batens developed the idea into a whole family of nonmonotonic logics with interesting properties, Adaptive Logics.)

Paraconsistent logics have many applications. They can be used as the inference engine for a computational database, where the data may not be reliable, or used to analyze the reasoning of inconsistent theories in the history of science—such as the original infinitesimal calculus or Bohr's theory of the atom. (The inconsistency of each of these was acknowledged in their times.) The same also holds true for the inconsistent but nontrivial theories that paraconsistent logic makes possible, including various mathematical theories. One can be interested in these because they have an intrinsically elegant structure, are instrumentally useful, and are good approximations to the truth. None of this requires one to suppose that the inconsistent theories may be true.

The view that some contradictions are true is dialeth(e)ism (a di/aletheia being a true statement of the form $A\&\neg A$). Unless a dialetheist takes everything to be true (not an attractive view!), they also require a paraconsistent logic. Though there have been dialetheists—such as Hegel—in the history of European philosophy, dialetheism is a strongly heterodox view because it flies in the face of the Law of Noncontradiction. The construction of contemporary paraconsistent logics has given the view a new lease of life. In particular, beginning in the 1970s, it was advocated by Priest and Richard Sylvan (né Routley).

Modern dialetheists argue for their view by appealing to certain features of motion, inconsistent systems of norms, and various other considerations. A major appeal has always been to the paradoxes of self-reference, such as the Liar and Russell's paradox (and related phenomena such as Gödel's incompleteness theorem). The paradoxical arguments are what they appear to be: arguments establishing that certain contradictions are true. In particular, a dialetheist can subscribe to the principles which generate these paradoxes: the unrestricted *T*-schema for truth ("*A*" is true iff *A*) and the unrestricted comprehension principle for sets (for any condition, there is a set comprising all and only those things satisfying that condition). In particular, it is possible to construct inconsistent but nontrivial theories containing these principles. Not all paraconsistent logics are suitable for this enterprise, however. In this context, any logic which endorses the principle of contraction ($A\rightarrow (A\rightarrow B) \vdash A\rightarrow B$) gives rise to triviality, in the form of Curry paradoxes. Such logics include the da Costa *C* logics and the stronger relevant logics.

See also Logic, History of; Logic, Non-Classical; Relevance (Relevant) Logics.

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PARADIGM-CASE ARGUMENT

"Paradigm-case argument" is a form of argument against philosophical skepticism found in contemporary analytic philosophy. It counters doubt about whether any of some class of things exists by attempting to point out paradigm cases, clear and indisputable instances. A distinguishing feature of the argument is the contention that certain facts about language entail the existence of paradigm cases. This claim, however, has been disputed in recent years, and the future status of the argument depends upon whether it can be upheld.