During the last hundred years the notion of time flow has been held in low esteem by philosophers of science. Since the metaphor depends heavily on the analogy with motion, criticisms of time flow have either attacked the analogy as poorly founded, or else argued by analogy from a "static" conception of motion. Thus (1) Bertrand Russell argued that just as motion can be conceived as existence at successive places at successive times without commitment to a state of motion at an instant, so duration can be conceived as existence at each of the times at which a thing exists without any commitment to a becoming or flow from one instant to another. I call this the "at-at" objection to time flow. A second objection (2) is that the sufficiency of the "B-theoretic" conception of time for physics makes the concept of time flow otiose. On this rendering the existence of a thing through time is just the "tenseless existence" of the thing at each instant of the duration (or at each spacetime point), without any flow from one instant or point to another. A third objection (3) is that in relativity theory, owing to the relativity of simultaneity, there is no unique invariant 'now', or hyperplane of simultaneously occurring events. If time flow is conceived in terms of the flow of such a 'now', then the non-existence of a worldwide instant of occurrence appears to be refuted. Lastly, (4) a capstone to these criticisms is the objection famously raised by Jack Smart: if rate of flow of any quantity can only be reckoned with respect to time, then with respect to what does time flow? If it does not even make sense to ask how fast time flows, then surely the metaphor should be abandoned as confused.

In this paper I offer a defence of the notion of time flow against these criticisms. The objection from the absence of a worldwide now (3) is seen to evaporate once one appreciates the changes in the ontology of time necessitated by relativity theory. As has been argued by several recent authors (Dieks 2006, Arthur 2006, Peacock 2006, Savitt 2007), time lapse in relativity theory is parametized by the proper time, which is a path-dependent variable. Becoming or time flow is a local phenomenon, constituted by the evolution of processes along their worldlines. The fact that there is no worldwide instant is therefore no objection to time flow so conceived.

It has been correctly observed by Smart and others that it makes no sense to conceive of becoming in terms of the flow of a point along an already given line in spacetime. The reason for this is that a spacetime trajectory is a 4-dimensional object: it already represents a motion in time. To require a further motion of a point along this worldline is at once to spatialize spacetime, and to make an illegitimate appeal to a second time dimension. By the same token, however, it is not appropriate to refer to a spacetime representation as yielding a "static" conception of time. 4-dimensional objects neither change nor stay the same, since they are not objects existing in time. To regard time or spacetime as static or eternally existing involves the same error as asking for a moving now to be represented on a spacetime diagram: it is a confusion of representation for the thing represented (Dorato 2006, Arthur 2006). In agreement with Savitt (2006, etc.) and Dorato (2006), and contra (3), I argue that there is no sense of "existence" which will

support an inference from a spacetime representation to the unreality of becoming: the sense in which 4-dimensional objects like spacetime "exist" is not a temporal one, and each event becomes or exists at the point of spacetime at which it is located.

One thing that appears to be missing from the spacetime representation, however, is a notion of passage or transition from one event to another. This is the nub of the "at-at objection" (2). According to Russell, "Weierstraß, by strictly banishing from mathematics the use of infinitesimals, has at last shown that we live in an unchanging world, and that the arrow in its flight is truly at rest... People used to think that when a thing changes, it must be in a state of change, and that when a thing moves, it is in a state of motion. This is now known to be a mistake. ... Motion consists merely in the fact that bodies are sometimes in one place and sometimes in another, and that they are at intermediate places at intermediate times." This is hardly a compelling argument. In the first place, you can be as Weierstraßian as you like about the continuum, yet you can still define a function which assigns a value for the velocity of the arrow at each instant: this will be zero for the arrow at rest at every instant of the motion, and non-zero for the moving arrow. But, even putting that aside, the argument appears to involve a fallacy of composition: events could be point events, and still they could compose a continuous process of becoming. There can be becoming across an interval even if there is none in a point-instant, just as there can be motion across an extended interval even if there is none in a point-instant. Whether or not there are infinitesimals in the continuum, a continuous flux of time is no more problematic than a continuous motion.

Finally, I proceed to Smart's objection (how fast does time flow, (4)), which, I argue, is not as strong an argument as it is widely taken to be. Beginning with an analysis of the motivations for the metaphor in classical physics, I argue that for Barrow the flux of time is represented by the rate of change of a process taken to be equable; Newton argues that although there may be no such equable process in reality, an equably flowing time must be presupposed in order to judge the degree of equability of all relative times. The flow of time is the successive coming into existence of events or states at successive moments of absolute time, rather than any of the particular relative times.

Things are different in the relativistic context, where there is no global plane of becoming. But, as I have argued, the rate at which processes occur is measured along their worldlines by the proper time. When we compare the rates of the same type of processes (such as, the aging of two twins taking differently accelerated paths through spacetime), we are presented with the scenario where, relative to one another, the twins age differentially. Generalizing, we can say processes occur at different rates along different timelike paths in spacetime, as measured by their proper durations. This, I suggest, does not just open up the possibility of time flowing at different rates, but confirms it in fact.