Are the Laws of Logic Laws of Nature?

3.1 Arguments Pro

3.1.1 If the laws of logic are applicable to all objects whatsoever they are also applicable to the objects dealt with by the natural sciences. Now a law is certainly applicable to some domain of objects if all the objects of this domain satisfy the law. Thus if the laws of logic are satisfied by all objects whatsoever they are also satisfied by the objects dealt with by the natural sciences. But those laws which are satisfied by the objects dealt with by the natural sciences are called laws of nature. Consequently: if the laws of logic are applicable to all objects whatsoever then the laws of logic are also laws of nature. Now, according to Kant the laws of logic are applicable to all objects whatsoever: “Die Logik ist ... eine Wissenschaft a priori von den notwendigen Gesetzen des Denkens, aber nicht in Ansehung besonderer Gegenstände, sondern aller Gegenstände überhaupt.”¹

Therefore: the laws of logic are also laws of nature.

3.1.2 If logic is the most general of all sciences then its universe of discourse (UL) includes the universes of discourse of all other sciences and so also that of the natural sciences (UN), i.e. UN ⊂ UL. It follows from this that the laws of logic which rule the elements of UL rule also the elements of UN. But the laws which rule the elements of UN are called laws of nature. Consequently if logic is the most general of all sciences then the laws of logic are laws of nature, since they rule the elements of UN. Now as Leibniz and Gödel say logic is the most general of all sciences: “Logica est scientia generalis”² – “it is a science prior to all others, which contains the ideas and principles underlying all sciences.”³

Therefore: The laws of logic are also laws of nature.

¹ Kant (1800, Lg), A4.
² Leibniz (1903, OFI), p. 557.
³ Gödel (1944, RML), p. 125.
3.1.3 If the laws of logic can be either justified by sense perception or falsified and revised by contingent facts then they are rather laws of thought or laws of thought processes and not – as Frege said – laws of truth.\textsuperscript{4} And if they are laws of thought or thought processes they are laws of nature. Now as Gödel says of Russell the laws of logic can be justified by sense perception:

“He [Russell] compares the axioms of logic and mathematics with the laws of nature and logical evidence with sense perception, so that the axioms need not necessarily be evident in themselves, but rather their justification lies (exactly as in physics) in the fact that they make it possible for these ‘sense perceptions’ to be deduced.”\textsuperscript{5}

Moreover as Quine says the laws of logic can be revised or superseded like one physical theory supersedes another:

“Conversely, by the same token, no statement is immune to revision. Revision even of the logical law of the excluded middle has been proposed as a means of simplifying quantum mechanics; and what difference is there in principle between such a shift and the shift whereby Kepler superseded Ptolemy, or Einstein Newton, or Darwin Aristotle?”\textsuperscript{6}

Therefore: The laws of logic are laws of nature.

3.1.4 Any formal language of science contains the most general laws of logic. Truth can be introduced w.r.t. these general laws of logic by describing their invariance against changing elementary (atomic) sentences (with the predicates contained in them) with the help of substitution: “A logical truth, then, is definable as a sentence from which we get only truths when we substitute sentences for its simple sentences.”\textsuperscript{7} Now since the laws of logic (or the logical truths) are general they can be applied to any area of science outside logic; i.e. the substitution instances can be taken from mathematics, physics, biology, etc. But such substitution instances put constraints on the laws of logic according to limits of mathematical reasoning or limits of nature. That this is so can be seen from the following two examples:

(i) As Intuitionism points out, in the case of application to an infinite domain, $p \lor \neg p$ fails because neither $\exists x Fx$ holds in its intuitionistic interpretation (there is no construction of a natural number $k$ with a proof of $Fk$) nor $\neg \exists x Fx$ holds (there is no uniform proof for $\neg Fn$ for each $n$).

(ii) Since the principle of classical physics: \textit{Any two properties (quantities) out of all observables can be observed (measured) simultaneously} does not hold in quantum physics, the combination or fusion of arbitrary propositions

\textsuperscript{4} Frege (1969, NGS), p. 139.
\textsuperscript{5} Gödel (1944, RML), p. 127.
\textsuperscript{6} Quine (1951, LPV), p. 43.
\textsuperscript{7} Quine (1970, PLg), p. 50.