Conclusion

The main theorems of this study are included in chapters 5 and 6. Among them are positive results concerning the prospects of explaining correlations *via* statistical common cause systems. Perhaps of the biggest intuitive force is theorem 10: every probability space can be extended to a probability space which is causally closed. (Subsequent theorems express variations on this idea.) If we do not see a statistical common cause for two correlated events, it is only because we have directed our attention to the "wrong" probability space; there is an extension of it which leaves no correlations unexplained. However, as already mentioned in the introduction to this essay, this can be interpreted in two ways. On the one hand, it is always nice to have a general positive theorem about the applicability of some interesting notion. On the other hand, in this case the applicability may be strictly mathematical. It is by no means evident that the statistical common causes present in the "extended" spaces will have much to do with what we would naturally accept as causes.

Consider again the example of particle decay from section 1.4.1. The momentum of one part of the particle is determined in accordance with the principle of conservation of total momentum by the momentum of the other particle part. Suppose the experimental setup is described by a probability space $\mathcal{S}$. The state of the particle before the decay event is, in this space, not a screener-off for the values of momentum after the split. Consider then the causally closed space $\mathcal{S}'$, which is an extension of $\mathcal{S}$, and which has to exist by theorem 10. In this space the momenta of the two parts of the decayed particle possess a statistical common cause which screens off one from the other. But do we really expect such a screener to have anything to do with the true causal picture? Are we not fully satisfied with the explanation consisting of the principle of conservation of total momentum coupled with the information on the genesis of the two particle parts?

Due to the generality of theorem 10 it is true that the "big space" used in the eponymous approach to the Bell inequalities can also be extended to a causally closed space—in which all correlations have common causes. This may be surprising if one thought that this should lead to the empirically falsified inequalities. This is, however, not the case, since—as already noted–in the "big space" approach the EPR-type correlations are in fact *conditional* correlations and so do not fall under the scope of theorem 10. And if we move to the "many spaces" approach then each of the "small" spaces will have their own causally closed extension. However, it is by no means evident that Parameter Independence, Outcome Independence and No Conspiracy should hold for the "extended" spaces.

In conclusion, we should better be skeptical towards a general application of explaining correlations by means of purely probabilistically-defined notions. Those employed in this essay, from Reichenbach's common cause as the middle element of a conjunctive fork, through statistical common cause systems, to *deductive explanantes*,

share (apart from screening off considered in isolation) the deductive explanatory feature described in section 2.1. This is a pleasing fact which strengthens the case for such notions playing a role in explanation but it is clearly not enough, e.g. since the correlation itself—as well as many other more or less trivially equivalent (sets of) conditions—also has that particular feature. There is of course more to causal explanation than pure statistics. However, mathematical methods like the algorithm of constructing SCCs and SCCSs used in the proof of theorem 4 could perhaps provide *candidates* for explanations—for example, they may suggest searching for traits possessed by certain subsets of the examined population—which can subsequently be studied by applying other methods: using the previous knowledge of mechanisms operating in the given context. This is at least *a priori* possible but if someone is of the opinion that the prospects are rather dim I will not try to convince them otherwise.

If the Reader will allow me a tongue-in-cheek remark, I think we could say that in light of the results of the previous chapters the atomless probability spaces offer us something akin to "Reichenbach's paradise": a realm in which all correlations are explained by factors satisfying Reichenbach's conditions. Now the task would be to find a guide through that paradise, a—presumably non-mathematical—tool for staying on the road of real causal explanation and steering away from bogus, non-explanatory constructions.

This is because the various results in this book suggest the possibility of upholding the PCC "against all odds", by pointing to SCCs (or SCCSs etc.) of the supposedly unexplained correlations in an empirically adequate probability space. The chief worry is that cause-wise and explanation-wise these might simply be "false positives"—events (or constructions made of events) satisfying the probabilistic requirements but not corresponding to anything causally and / or explanatorily relevant. But since the theorems already employ a notion of independence, which invites the use of background causal knowledge in order to exclude some pairs of logically independent events from the considerations (since correlations between them are not surprising, because e.g. we already know one is a cause of the other), why not invite the use of similar knowledge again, this time on the level of Reichenbach-style explanations of correlations? The results in this book could perhaps be seen as usable as a mathematical "bridge" between two applications of background causal knowledge:

- first, the background causal knowledge determines which correlations between logically independent events demand explanation;
- then the theorems from chapters 5 and 6 point to candidates for such explanation;
- then the background causal knowledge allows us to "weed out" the obviously irrelevant among those explanations.

At this point I am unfortunately unable to say anything specific on this issue. It is not clear to me whether any specific picture of causality would fit better with such a view of the PCC than any other. Perhaps some pluralistic account of causality and explanation of correlations is possible, one which would combine a probabilistic analysis of

some aspects of causality with e.g. a mechanistic (or some other) analysis of different aspects. Whether such an approach is indeed possible would be a topic for another book. I would very much like to read such a book some day but right now I would not even be able to begin writing it. This is the time to stop, then.