Also, we see clearly how mistaken Souriau was, certainly because he did not direct inquiries among scholars, when he spoke of them as being desirous of some great discovery "in order to attract public attention" or, "to get an agreeable and independent appointment." We can admit that motives of that kind occasionally influence the life of some of us—when tempted to slacken our work—as did the classic word: "Thou sleepest, Brutus." It is possible that Ampère was doing more than answering Julie Ampère's urgent anxieties when he wrote her that publishing one of his discoveries would be a good means of securing a professorship in a lycée. But it was not that which made him discover; nor could I conceive of a scientific man who would be led to discover chiefly in that way. Scholars with minds of that sort could get only poor results; whether it be in the choice of questions or in their treatment, a man without some love of science could not be successful, because he would be unable to choose.[6]

Final Remarks

I have tried to report and interpret observations, personal or gathered from other scholars engaged in the work of invention. There remain many other important aspects

[6] Points of view substantially analogous to ours in this section are the object of G. H. Hardy's recent and suggestive little book *A Mathematician's Apology*. Although he does not get to a complete definition of the beauty—or, as he calls it, "seriousness"—of a mathematical question or result, on which, of course, esthetic feeling must intervene, he gives a very delicate and acute analysis of the conditions suitable for the approach to such a definition.

He also discusses the motives which may influence the desire of research. He sees three chiefly important ones, the first of them being, of course, the desire to know the truth. For the reason given in the text, I should insist more than he does on the predominant character and even necessity of that first one.

of the subject, especially "objective" ones, which we have already had occasion to mention. Such are the possible relations between inventive thought and bodily phenomena. Ideas more or less analogous to those of Gall would deserve to be pursued. But how could this be done? It would require somebody more qualified than I am—better acquainted with the physiology of the brain. However, here we meet with the difficulty which we mentioned in the beginning; while mathematicians have not sufficient knowledge of neurology, neurologists cannot be expected to penetrate deeply (as would be necessary) into mathematical studies. Will it ever happen that mathematicians will know enough of that subject of the physiology of the brain and that neurophysiologists know enough of mathematical discovery for efficient cooperation to be possible?

Similarly, I could not venture to say anything about the social and historical influences which surely act on invention as they do on everything else. I do not know much about the mechanism of that influence; and the question is whether anybody does. Such attempts as Taine's in his *Philosophie de l'Art*, although their principle bears the mark of genius, are certainly premature and very hypothetical in their conclusions. Indeed, the difficulties of such an attempt are obvious: not only is there the fact that no experiment is possible, but even (genius apart) men with notable inventive powers are too rare to allow an extensive application of comparative methods, so that Taine's question and our own are among the most difficult even between those of an historical nature. Social influences govern mathematical development in the same unconscious and rather mysterious way as they do literary or artistic ones. There may certainly be something right in Klein's idea of

an intervention of Galton's heredity theories as concerns intuitive and logical qualities of the mind (and the same might be said of mathematical aptitude in general and of the way various minds use concrete representations); but it is quite unlikely that things are as simple as was imagined by the school of Taine. It is certainly not a fortuitous thing that, at the time of the Renaissance and especially in Italy, there were so many extraordinary men of every kind, a Benvenuto Cellini and a Leonardo da Vinci as well as a Galilei; but it is more doubtful that the reasons for such a marvellous phenomenon are those supposed by Taine.[1]

Things may eventually be clearer when, instead of general cases, we consider some individual ones. Saying that, I think of the case of Cardan, who lived at that same time and who, in fact, was one of the most extraordinary characters of that extraordinary time. It could be naturally expected that that discovery of imaginaries which seems nearer to madness than to logic and which, in fact, has illuminated the whole mathematical science, would come from such a man whose adventurous life was not always commendable from the moral point of view, and who from childhood suffered from fantastic hallucinations to such an extent that he was chosen by Lombroso as a typical example in the chapter "Genius and Insanity" of his book on *The Man of Genius*.

If we do not recur to such special cases, the exceptional

[1] Is the similitude in the evolution of ideas among Greek philosophers and among thinkers posterior to Jesus Christ, as concerns words and wordless thought, more than a fortuitous coincidence, and would it mean a general law in the evolution of thought? Of course, one should not dare to make a positive assertion on the basis of only two instances. If proved, the fact would be a rather significant one. A study on that question in Arabian philosophy (especially in the Spanish period) or in Asiatic philosophies could be of interest.

character of the phenomena which we have considered creates an obstacle to study as soon as one leaves aside the data supplied by introspection. But, on the other hand, one may wonder whether such processes cannot help us to elucidate those which go on in other psychological realms: for instance, as we have seen, those examined in Section VI may have some features in common with the role of images as considered by Taine or with problems raised by the Gestalt theory. In conformity with a rule which seems applicable to every science of observation (that it even applies in mathematics appears from the fact noticed in Section VIII, p. 117 footnote), it is the exceptional phenomenon which is likely to explain the usual one; and, consequently, whatever we can observe that has to do with invention or even, as in this study, this or that kind of invention, is capable of throwing light on psychology in general.