THE CHOICE OF FACTS.[1]

TOLSTOY somewhere explains why "science for its own sake" is in his eyes an absurd conception. We cannot know *all* facts, since their number is practically infinite. It is necessary to choose; then we may let this choice depend on the pure caprice of our curiosity. Would it not be better to let ourselves be guided by utility, by our practical and above all by our moral needs? Have we nothing better to do than count the number of lady-bugs on our planet?

It is clear the word "utility" has not for him the sense men of affairs give it, and following them most of our contemporaries. Little cares he for industrial applications, for the marvels of electricity or of automobilism, which he regards rather as obstacles to moral progress; utility for him is solely what can make man better.

For my part, it need scarce be said, I could never be content with either the one or the other ideal; I would not wish either a grasping and mean plutocracy nor a goody and mediocre democracy which is occupied solely in turning the other cheek, where sages would dwell without curiosity, and, shunning excess, would not die of disease to be sure, but would certainly perish of ennui. But that is a matter of taste and is not what I wish to discuss.

The question nevertheless remains and should fix our

[1] Translated from the French by G. B. Halsted.

attention; if our choice can only be determined by caprice or by immediate utility, there can be no science for its own sake, and consequently no science. But is that true? That a choice must be made is incontestable; however active we may be, facts move faster than we, and we cannot catch up with them. While the scientist discovers one fact, milliards on milliards are taking place in a cubic millimeter of his body. To try to comprehend nature in science would mean to put the whole into the part.

But scientists believe that there is a hierarchy of facts and that a judicious choice may be made among them. They are right, since otherwise there would be no science, and science exists. One need only open his eyes to see that the conquests of industry which have enriched so many practical men would never have seen the light, if these practical men alone had existed and if they had not been preceded by unselfish devotees who died poor, who never thought of utility, and yet had a guide far other than caprice.

As Mach says, these devotees have spared their successors the trouble of thinking. Those who might have worked solely in view of an immediate application would have left nothing behind them, and, in the face of a new need, all must have been begun over again. Now most men do not love to think, and this is perhaps fortunate when instinct guides them, for most often, when they pursue an aim which is immediate and ever the same, instinct guides them better than reason would direct a pure intelligence. But instinct is routine, and if thought did not fecundate it, it would make no more progress in man than in the bee or ant. It is needful then to think for those who do not like to think, and as these are numerous, it is needful that each of our thoughts be useful as often as possible, and this is why a law will be the more precious according as it is the more general.

This shows us how we should choose: the most interesting facts are those which may serve many times; these are the facts which have a chance of coming up again. We have been so fortunate as to be born in a world where there are such. Suppose that instead of 60 chemical elements there were 60 milliards of them, that they were not, some common the others rare, but that they were uniformly distributed. Then every time we picked up a new pebble there would be a great probability of its being formed of some unknown substance. All that we knew of other pebbles would be worthless for it. Before each new object we should be as the new-born babe; like it we could only obey our caprices or our needs. In such a world there would be no science; perhaps thought and even life would be impossible, since evolution could not develop there the preservational instincts. Happily it is not so; like all god fortune to which we are accustomed, this is not appreciated at its true worth. The biologist would be just as perplexed if he had only individuals and no species, and if heredity did not make sons resemble their fathers.

Which, then, are the facts likely to reappear? First of all, they are the simple facts. It is clear that in a complex fact a thousand circumstances are united by chance, and that only a chance still much less probable could reunite them anew. But are there any simple facts? And if there are, how recognize them? What assurance is there that a thing we think simple does not hide a dreadful complexity? All we can say is that we ought to prefer the facts which *seem* simple to those where our crude eye discerns unlike elements. And then we have one of two things: either this simplicity is real, or else the elements are so intimately mingled as not to be distinguishable. In the first case there is chance of our meeting anew this same simple fact, either in all its purity or entering as an ele-

ment in a complex manifold. In the second case this intimate mixture has likewise more chances of recurring than a heterogeneous assemblage. Chance knows how to mix, it does not know how to disentangle, and in order to construct with multiple elements a well-ordered edifice in which something is distinguishable, it is necessary to make it expressly. The facts which appear simple, even if they are not so, will therefore be more easily revived by chance. This it is which justifies the method instinctively adopted by the scientist, and what justifies it still better, perhaps, is that oft-recurring facts appear to us simple, precisely because we are used to them.

But where is the simple fact? Scientists have been seeking it in the two extremes, in the infinitely great and in the infinitely small. The astronomer has found it because the distances of the stars are immense, so great that each of them appears but as a point, so great that the qualitative differences are effaced, and because a point is simpler than a body which has form and qualities. The physicist, on the other hand, has sought the elementary phenomenon in fictitiously cutting up bodies into infinitesimal cubes, because the conditions of the problem, which undergo slow and continuous variation in passing from one point of the body to another, may be regarded as constant in the interior of each of these little cubes. In the same way the biologist has been instinctively led to regard the cell as more interesting than the whole animal, and the outcome has shown his wisdom, since cells belonging to the most diverse organisms are more alike, for one who can recognize their resemblances, than are these organisms themselves.

The sociologist is more embarrassed; the elements which for him are men, are too unlike, too variable, too capricious, in a word, too complex themselves. Besides, history never begins over again; how then choose the interesting fact, which is the one that begins again? Method

is precisely the choice of facts; it is needful then to be occupied first with creating a method, and many have been imagined, since none imposes itself. Each thesis in sociology proposes a new method, which however the new doctor is careful not to apply, so that sociology is the science with the most methods and fewest results.

Therefore it seems best to begin with the regular facts; but after the rule is well established, after it is beyond all doubt, the facts in full conformity with it are ere long without interest since they no longer teach us anything new. It is then the exception which becomes important. We cease to seek resemblances; we devote ourselves above all to differences, and among the differences are chosen first the most accentuated, not only because they are the most striking, but because they will be the most instructive.

I will endeavor to render this thought more plain by a simple example. Let us assume that some one wishes to determine a curve which he does by observing some of its points. The practical man who concerns himself only with immediate utility would observe only the points he might need for some special purpose. These points would be badly distributed on the curve; they would be crowded in certain regions, rare in others, so that it would be impossible to join them by a continuous line, and they would be unavailable for other applications. The scientist will proceed differently; as he wishes to study the curve for itself, he will distribute regularly the points to be observed, and when enough are known he will join them by a regular line and then he will have the entire curve. But to accomplish this, how does he proceed? If he has determined an extreme point of the curve, he does not stay near this extremity, but goes first to the other end; after the two extremities the most instructive point will be the center and so on.

So when a rule is established we should first seek the cases where this rule has the greatest chance of failing. Thence, among other reasons, come the interest of astronomic facts and the interest of the geologic past. By going very far away in space or very far away in time, we may find our usual rules entirely overturned, and these grand overturnings aid us the better to see or to understand the little changes which may happen nearer to us, in the little corner of the world where we are called to live and act. We shall know this corner better for having traveled in distant countries with which we have nothing to do.

But what we ought to aim at is less the ascertainment of resemblances and differences than the recognition of likenesses hidden under apparent divergences. Particular rules seem at first discordant, but looking more closely we see that in general they resemble each other; different as to matter, they are alike as to form, as to the order of their parts. When we look at them in this way, we shall see them enlarge and tend to embrace everything. And this it is which makes the value of certain facts which come to complete an assemblage and to show that it is the faithful image of other known assemblages.

I will not insist further, but these few words suffice to show that the scientist does not choose at random the facts he observes. He does not, as Tolstoy says, count the lady-bugs, because, however interesting lady-bugs may be, their number is subject to capricious variations. He seeks to condense much experience and much thought into one slender volume; and that is why a little book on physics contains so many past experiences and a thousand times as many possible experiences whose result is known beforehand.

But we have as yet looked at only one side of the question. The scientist does not study nature because it is useful; he studies it because he delights in it, and he de-

lights in it because it is beautiful. If nature were not beautiful, it would not be worth knowing, and if nature were not worth knowing, life would not be worth living. Of course I do not speak here of that beauty which strikes the senses, the beauty of qualities and appearances; not that I undervalue such beauty, far from it, but it has nothing to do with science. I mean that profounder beauty which comes from the harmonious order of the parts and which a pure intelligence can grasp. This it is which gives body, a structure so to speak, to the iridescent appearances which flatter our senses, and without this support, the beauty of these fugitive dreams would be only imperfect, because it would be vague and always fleeting. On the contrary, intellectual beauty is sufficient unto itself, and it is for its sake, more perhaps than for the future good of humanity, that the scientist devotes himself to long and difficult labors.

It is, therefore, the quest of this special beauty, the sense of the harmony of the cosmos, which makes us choose the facts most fitting to contribute to this harmony, just as the artist chooses from among the features of his model those which perfect the picture and give it character and life. And we need not fear that this instinctive and unavowed prepossession will turn the scientist aside from the search for the true. One may dream a harmonious world, but how far will the real world leave it behind! The greatest artists that ever lived, the Greeks, made a heaven of their own; how shabby it is beside the true heaven, ours!

And it is because simplicity, because grandeur, is beautiful, that we preferably seek simple facts, sublime facts; that we delight now to follow the majestic course of the stars, now to examine with the microscope that prodigious littleness which is also a grandeur, now to seek in geologic

time the traces of a past which attracts us because it is far away.

We see too that the longing for the beautiful leads us to the same choice as the longing for the useful. And so it is that this economy of thought, this economy of effort, which is, according to Mach, the constant tendency of science, is at the same time a source of beauty and a practical advantage. The edifices that we admire are those where the architect has known how to proportion the means to the end, where the columns seem to carry gaily, without effort, the weight placed upon them, like the gracious caryatids of the Erechtheum.

Whence comes this concordance? Is it simply that the things which seem beautiful to us are those which best adapt themselves to our intelligence, and that consequently they are at the same time the implement this intelligence knows best how to use? Or is there here a play of evolution and natural selection? Have the peoples whose ideal most conformed to their highest interest exterminated the others and taken their place? All pursued their ideals without reference to consequences, but while this quest led some to destruction, to others it gave empire. One is tempted to believe it. If the Greeks triumphed over the barbarians and if Europe, heir of Greek thought, dominates the world, it is because the savages loved loud colors and the clamorous tones of the drum which occupied only their senses, while the Greeks loved the intellectual beauty which hides beneath sensuous beauty, and that this intellectual beauty it is which makes intelligence sure and strong.

Doubtless such a triumph would horrify Tolstoy, and he would not like to acknowledge that it might be truly useful. But this disinterested quest of the true for its own beauty is sane also and able to make man better. I know well that there are mistakes, that the thinker does

not always draw thence the serenity he should find therein, and even that there are scientists of bad character. Must we, therefore, abandon science and study only morals? What! Do you think the moralists themselves are irreproachable when they come down from their pedestals?

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