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# Dear Pythagoras: See What You Started

by Barbara B. Cook

*(Editors Note: What follows seems to be a letter to Pythagoras. There is no signature, but one can infer from the contents that the writer was a remarkably long lived student or colleague of Pythagoras. Ms. Cook has offered no explanation of how this document came into her hands.)*

Dear Pythagoras:

Since I last wrote to you, much has happened in the Field of Mathematics. We have been praised,

*Accurate reconing. The entrance into the knowledge of all existing things and all obscure secrets.*

*The Ames Papyrus*

maligned,

*I have hardly ever known a mathematician who was capable of reasoning.*

*Plato: The Republic*

defended,

*And for mathematical science, he that doubts their certainty hath need of a dose of hellebore.*

*Joseph Glanvill*

and ridiculed,

*The different branches of Arithmetic — Ambition, Distraction, Uglification, and Derision.*

*The Mock Turtle*

*Alice in Wonderland.*

We have engaged in self criticism,

*There is a tradition of opposition between adherents of induction and of deduction. In my view it would be just as sensible for the two ends of a worm to quarrel.*

*Alfred North Whitehead*

self examination,

*What we know is not much;  
What we do not know is immense.*

*P. S. Laplace*

and even self-doubt,

*All my zeal has been mocked.*

*Jacques Bernoulli*

We have, at times, overstated our case,

*Geometry is the only science that it hath pleased God hitherto to bestow on mankind.*

*Thomas Hobbes*

and our opponents have, at times, overstated theirs,

*In mathematics dullness is thus elevated into talent, and talent degraded into incapacity.*

*Sir William Hamilton*

But throughout it all, we have endured.

Ever since Plato responded to the question "What does God do?" with the (obvious?) answer: "God ever geometrices," mathematicians have tried to put mathematics into proper perspective in the universe. This, of course, was not the only time this question was asked (or answered):

*God ever arithmetices*

*C. G. J. Jacobi*

*God created the natural numbers  
everything else is man's handiwork.*

*L. Kronecker*

But, it has also been said,

*There is no greater mistake than to call arithmetic an exact science.*

*Mrs. LaTouche (19th Century)*

If we have felt close to nature,

*All the effects of nature are only the mathematical consequences of a small number of immutable laws.*

*P. S. Laplace*

perhaps it was because of your remark,

*Number rules the universe.*

*Pythagoras*

If its effect on us has been profound,

*The infinite! No other question has ever moved so profoundly the spirit of man.*

*David Hilbert*

its effect on others has been no less so,

*Mathematics seems to endow one with something like a new sense.*

*Charles Darwin*

Even when some of us expressed concern,

*One cannot escape the feeling that these mathematical formulae have an independent existence and an intelligence of their own, that they are wiser than we are, wiser even than their discoverers, that we get more out of them than was originally put into them.*

*Heinrich Hertz*

others were strong in their convictions.

*The science of pure mathematics, in its modern developments, may claim to be the most original creation of the human spirit.*

*Alfred N. Whitehead*

even if their convictions were diametrically opposed,

*I admit that mathematical science is a good thing. But excessive devotion to it is a bad thing.*

*Aldous Huxley*

We have tried to define our subject in both grandiose terms,

*Pure mathematics consists entirely of assertions to the effect that, if*

*such and such a proposition is true of anything, then such and such another proposition is true of that thing. It is essential not to discuss whether the first proposition is really true, and not to mention what the anything is, of which it is supposed to be true. . . If our hypothesis is about anything, and not about some one or more particular things, then our deductions constitute Mathematics. Thus mathematics may be defined as the subject in which we never know what we are talking about, nor whether what we are saying is true.*

*Bertrand Russell*

as well as simplistic ones,

*Mathematics is the science which draws necessary conclusions.*

*Benjamin Pierce*

There is a nonsense side of the subject,

*In the space of one hundred and seventy-six years the Lower Mississippi has shortened itself two hundred and forty-two miles. That is an average of a trifle over one mile and a third per year. Therefore, any calm person, who is not blind or idiotic, can see that in the Old Oolitic Silurian Period, just a million years ago next November, the Lower Mississippi River was upward of one million three hundred thousand miles long, and stuck out over the Gulf of Mexico like a fishing-rod. And by the same token any person can see that seven hundred and forty-two years from now the Lower Mississippi will be only a mile and three-quarters long, and Cairo and New Orleans will have joined their streets together, and be plodding comfortably along under a single mayor and a mutual board of aldermen. There is something fascinating about science. Once gets such wholesale returns of conjecture out of such a trifling investment of fact.*

*Mark Twain (Life on the Mississippi)*

as well as a serious side,

*Thought is only a flash between two long nights, but this flash is everything.*

*Henri Poincaré*

Plato inscribed above the entrance to his academy, "let no man ignorant of geometry enter here." Since then the areas of mathematics have become very diverse, but each of them has enjoyed a special place in our hearts.

*What would life be without arithmetic, but a scene of horrors.*

*Sidney Smith*

*Life is a school of probability.*

*Walter Bagehot*

*Mathematics is the queen of the sciences and number theory is the queen of mathematics.*

*Gauss*

*(Analytic Geometry) . . . immortalized the name of Descartes, and constitutes the greatest single step ever made in the progress of the exact sciences.*

*John Stuart Mill*

*Whenever groups disclosed themselves, or could be introduced, simplicity crystallized out of comparative chaos.*

*E. T. Bell*

*Projective geometry has opened up for us with the greatest facility new territories in our science, and has rightly been called a royal road to its own particular field of knowledge.*

*Felix Klein*

*Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write.*

*H. G. Wells*

*It is remarkable that this science (Probability), which originated in the consideration of games of chance, should have become the most important object of human knowledge.*

*P. S. Laplace*

But even here our detractors are present,

*Logic is neither a science nor an art; but a dodge.*

*Benjamin Jowett*

*Mathematics may distort, but can never rectify, the mind.*

*Sir William Hamilton*

While we have been reluctant to make absolute judgements,

*He who has heard the same thing told by 12,000 eye witnesses has only 12,000 probabilities, which equals one strong probability, which is far from certainty.*

*Voltaire*

*A reasonable probability is the only certainty.*

*E. W. Howe*

those around us have not,

*Round numbers are always false.*

*Samuel Johnson*

When we expressed small doubts,

*Is probability probable?*

*B. Pascal*

others became more brazen,

*There are three kinds of lies: lies, damned lies, and statistics.*

*Disraeli*

Criticism accepted from within,

*It is annoying to dwell upon such trifles (probability); but there is a time for trifling.*

*B. Pascal*

sometimes becomes unacceptable when leveled from without,

*An excessive study of mathematics absolutely incapacitates the mind.*

*Sir William Hamilton*

Although mathematics inspired many great writers,

*Lest men suspect your tale untrue,  
keep probability in view.*

*John Gay*

*Nature and nature's laws lay hid in night,  
God said, "let Newton be" and all was light.*

*Alexander Pope*

there were those who were turned off by its excessive reliance on logic,  
*Logic, like whiskey, loses its beneficial affect when taken in too large  
quantities.*

*Lord Dunsany*

Newton once said, "If I have seen further than others, it is because I stood  
on the shoulders of giants." Through the centuries, much praise has been  
given to these "Giants",

*... There was far more imagination in the head of Archimedes than in  
that of Homer.*

*Voltaire*

*(Newton) was the greatest genius the world has ever seen — and the  
most fortunate, for only once can it be given a man to discover the sys-  
tem of the universe.*

*Lagrange*

*He (Euler) calculated just as men breath, as eagles sustain themselves  
in the air.*

*Francois Arago*

*He (Abel) has left mathematicians something to keep them busy for  
five hundred years.*

*Hermite*

*Lagrange is the lofty pyramid of the mathematical sciences.*

*Napoleon Bonaparte*

We have also been quick to criticize each other when we thought the need  
arose,

*Pascal was without a doubt the greatest might-have-been in the history  
of mathematics.*

*C. B. Boyer*

*Our friend Euler is a great mathematician, but a bad enough philoso-  
pher.*

*Lagrange*

*The cowboys have a way of trussing up a steer or a pugnacious bronco  
which fixes the brute so that it can neither move nor think. This is the  
hog-tie, and it is what Euclid did to geometry.*

*E. T. Bell*

*The race of circle squarers will never die as long as ignorance and the  
thirst for glory remain united.*

*H. Schubert*

even if our criticism was misplaced as when Gauss once remarked after re-  
ceiving a paper from Abel, "Here is another of those monstrosities."

Attempts to analyse mathematicians were at times naive,  
*Mathematicians are like lovers . . . Grant a mathematician the least principle, and he will draw from it a consequence which you must also grant him, and from this consequence another.*

Fontenelle

*Mathematicians are like Frenchmen: whatever you say to them they translate into their own language, and forthwith it is something entirely different.*

Goethe

but were underlined by respect,

*It is easier to square a circle than to get round a mathematician.*

Augustus De Morgan

There has always been a friendly rivalry between those who work entirely on paper and those who think we should spend more time in the laboratory,

*The proof is performed in the laboratory.*

Oliver Heaviside

*Why think? Why not try the experiment?*

John Hunter

*When I attack a problem experimentally it is a proof that the problem is mathematically impregnable.*

Ernst Kummer

*The essential fact is that all the pictures which science now draws of nature, and which alone seem capable of according with observational facts, are mathematical pictures.*

Sir James Jeans

Ever since Archimedes said, "give me a place to stand on, and I can move the earth," mathematicians have wrestled with the question of pure versus applied mathematics.

*It is a pleasant surprise to him (the pure mathematician) and an added problem if he finds that the arts can use his calculations, or that the senses can verify them, much as if a composer found that the sailors could heave better when singing his songs.*

George Santayana

*It is true that M. Fourier had the opinion that the principal aim of mathematics was public utility and the explanation of natural phenomena; but a philosopher like him should have known that the sole end of science is the honor of the human mind, and that under this title a question about numbers is worth as much as a question about the system of the world.*

Carl Jacobi

But perhaps the difficulty of evaluating research was best illustrated by Michael Faraday when he was asked of what use was his discovery of electromagnetic induction and he responded,

*What is the use of a newborn baby?*

M. Faraday

In the 4th Century B.C., Alexander the Great asked his teacher Menaechmus for a short cut to Geometry and received the reply,

*O King, for traveling over the country, there are royal roads and roads for common citizens; but in Geometry there is one road for all.*

*Menaechmus*

Since then, mathematicians have freely given advice on how to study mathematics,

*What you have been obliged to discover by yourself leaves a path in your mind which you can use again when the need arises.*

*G. C. Lichtenberg*

*The reader who finds the mathematics too difficult in some places is advised to do what the mathematician will do when he finds it too trivial: skip it.*

*Petr Bechmann*

We have also freely expressed our opinion on how to do mathematics,

*Everything should be made as simple as possible, but not simpler.*

*A. Einstein*

*I do not frame hypotheses.*

*Isaac Newton*

*You must always invert.*

*Jacobi*

*Whenever you can, count.*

*Sir Francis Galton*

*A mathematician who is not also something of a poet will never be a complete mathematician.*

*Karl Weierstrass*

When asked how he made his great discoveries, Newton replied: "By always thinking unto them." Later, in response to the same question, he said, "I keep the subject constantly before me and wait till the first dawns open little by little into the full light." Others had equally relevant and important advice on this subject,

*By studying the masters, not their pupils.*

*Abel*

*Each problem that I solved became a rule which served afterwards to solve other problems.*

*Descartes*

*If I found any new truths in the sciences, I can say that they follow from, or depend on, five or six principal problems which I succeeded in solving and which I regard as so many battles where the fortune of war was on my side.*

*Descartes*

I hope, dear Pythagoras, that you have enjoyed this look at the field of mathematics through the perspective of history ("History repeats itself; historians repeat each other" — Philip Guedalla). I have tried not to philosophise too much ("Any philosophy that can be put "in a nutshell" belongs there." — Harris' law) nor to put any hidden meanings into what was said ("Are the planets inhabited?" — Napoleon Bonaparte). My only purpose was to lay the field before you and let you make your own value judgements. My only hope is that I have escaped the wrath of Byron — "with just enough learning to misquote." If I have lingered too long, it is because I have a precedent,

*I have made this letter longer than usual because I lacked the time to make it short.*

*B. Pascal*

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