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Applied Mathematics

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APPLIED MATHEMATICS

THE court mathematician's pupil was sitting dejectedly on a rustic seat in the beautiful gardens which surrounded the royal palace of Nunvalia. But it would be an error to call him the pupil of the court mathematician, for such he was no longer; neither was he, as a few short hours before, the accepted suitor of Angelina, the court mathematician's lovely daughter : hence the cause of his woe.

This is how it all happened. The court mathematician and his pupil had been working together on a mathematical problem of huge dimensions, and they had differed as to the result of one of their computations. It was a small point indeed, but when professional honor is involved there is no such thing as agreeing to disagree, as ordinary people may, even on a very insignificant point.

" The square of the cube root of the logarithm of the sine of 45° is 1.9731," said the court mathematician, firmly.

" The square of the cube root of the logarithm of the sine of 45° is 1.9732," replied his pupil, with equal decision.

" I said *one* ten-thousandth," retorted the court mathematician, warmly.

" Pardon me, *two* ten-thousandths," answered the pupil.

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The court mathematician glared at his pupil, and his pupil glared back in return.

"One," almost shouted the court mathematician; "and what is more, I command you not to contradict me."

His pupil was silent, but held up two fingers.

I will not describe how the anger of the court mathematician became a passion, and the passion a fury, and how in the latter state he ordered his pupil to leave the house and never dare to come there again; nor how he remained obdurate in his decision, in spite of all the supplications of his daughter, who even went so far as to throw herself on the floor and clasp his unrelenting knees.

So now Ferdinand — such was the name of the court mathematician's pupil that was — sat disconsolate and sweetheartless under the trees of the royal gardens, bemoaning his hard fate; naturally he fell into figures of speech suggested by his early training.

"Ah! she is the locus of all good traits," he murmured with a sigh. "Yes, her life is the curve toward which my own has been tending from the first. Once I believed mine to be the tangent to hers at finite distance; woe is me that I should find that it is an asymptote."

While Ferdinand was thus complaining, the Princess Elsa, the third and youngest daughter of King Adolphus of Nunvalia, who was strolling idly through the royal gardens, chanced to come that way, and hearing the young man's voice came a bit closer and peered through the shrubbery that surrounded the rustic seat, to see from whom the doleful sounds were coming.

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The required course in mathematics for princesses in Nunvalia at that time did not include analytics, and hence the Princess Elsa did not understand a word that the ex-pupil had uttered, but being a woman as well as a princess she was able to interpret pretty well the young man's sighs and woebegone countenance. Now the princess was tender-hearted, and a bit frolicsome too; so she determined to address this good-looking young man and inquire the cause of his grief; which she did accordingly.

It was an unwritten law at the court of Nunvalia that no man should express love for another woman in the presence of any of the ladies of the royal family; yet for all this Ferdinand need not have answered the princess just as he did, and thereby cause her to drop her eyes to the ground; perhaps he felt just a bit flattered by the sympathy of a princess.

That night the Princess Elsa related to her lady in waiting her conversation with the silly youth in the garden, and both mistress and maid laughed heartily over the story. Then they talked together in low voices — and if I should say what they said, it would spoil my story.

But if the princess thought of Ferdinand that evening, no vestige of remembrance of the princess remained in the mind of the court mathematician's ex-pupil; for it was on that evening that he had arranged a secret meeting with his Angelina, at an hour when the court mathematician would be sure to be lost in his calculations. And at the same time that the playful princess and her maid were maliciously plotting in the royal palace, out under the trees before

the court mathematician's house the two lovers were also contriving a plot from which, to judge from the beatific faces that the moonlight revealed, they expected the happiest outcome.

" Can you love me enough for that ? " asked the court mathematician's ex-pupil anxiously, as the time drew near when they must leave each other.

" Yes, when you have won the ruby," answered Angelina, prudently.

" Ah, where is the paper ? " he asked eagerly.

In answer the girl took from her bosom a bit of paper and handed it to him. They read it together in the moonlight.

" And *one* ten-thousandth," murmured Angelina, laughingly.

" Two, though," the ex-pupil answered doggedly.

" For my sake, one," she pleaded, putting her arms about his neck.

" Yes, for our sakes, one ; " and he kissed her.

It will be necessary before going any further to make a digression and speak of certain affairs of state in the kingdom of Nunvalia. King Adolphus of Nunvalia, like many another king, had found it frequently very difficult to collect the taxes due him from his subjects. He had tried imprisonment and even beheading as punishments for non-payment, but for all that many of his people had continued to spend all their money just before the tax-collector came to them, and then what was to be done ?

In this dilemma the king called to him his court economist and asked his advice. As a result, two years later there appeared an exhaustive treatise on

"Taxation" in fourteen volumes, written by the court economist, copies of which are still to be seen among the Nunvalian archives. The gist of the treatise was as follows : First, that it is very hard to take money out of a man's pocket when the man is looking — and especially when there is none there. "This," wrote the court economist, "is the difficulty in the system prevailing in Nunvalia." Second, it is easier to take money from a man's pocket when he is not looking. And third, it is easier still to do so when one makes a pretence of giving something in return.

"What pretence would you suggest ? " asked the king when the court economist had explained to him what there was in his fourteen volumes and what it meant.

"Theoretically," replied the court economist, cautiously, "it is not possible to get something in return for nothing; but considering that constant element in human nature which, for want of a better term, may be called the 'eternally gullible,' I think the result could be obtained approximately by means of a lottery."

But King Adolphus objected to a lottery. "The court moral and social philosopher," he said, "tells me that lotteries tend to cause a deterioration in public morality, and that is a thing I should like to avoid in the kingdom of Nunvalia."

But then a brilliant idea occurred to him. "I have it," he cried. "I will raise my taxes by means of a guessing game, the moral objections to which will be more than balanced by the educational advantages. This year I will have my people guess how

many beans there are in a bottle" (this game was then very popular in Nunvalia,) "each citizen paying so much for the privilege of guessing, and the one coming the nearest to the correct number receiving the valuable prize which I shall offer. Every year I shall have a new problem devised, and thus make revenue raising in my kingdom a great instrument for popular education."

The scheme was tried, and worked to perfection. The populace, who had heard what the problem was to be, got bottles of all shapes and sizes, and practised estimating their contents — measured in beans — until they became so accurate that when it came to the contest the guessing was very close indeed, and the very number guessed in fact, it being 11,989½, one bean having been split and the other half lost in the process of filling the jar.

This happened several years before the events of our story, and so pleased was King Adolphus with the results of his scheme that he continued it year after year. This particular year it was announced that a mathematical problem would be given in the annual contest; whereupon, to the king's great joy, all his people began to hunt up and study their old arithmetics. Furthermore the king announced that the prize would be nothing less than the third finest jewel of his crown, which, as was understood by all, was a very beautiful ruby of great size and value.

The problem was to be devised by the court mathematician. "It will give him something to do at last," said the king, delightedly. Heretofore the court mathematician's sole duty had been to ride in state processions, he being allowed at other times to

go triangulating among the stars at will, in the hope that in this way the stars might be discovered to be at some time of importance to the kingdom of Nunvalia.

Now on the paper which Angelina had given her lover was written the problem whose correct solution meant the possession of the ruby, itself a princely fortune.

The day of the contest came at last, and a vast multitude was assembled in the public square of the capital, some to try for the prize, others as mere onlookers. A throne had been raised at one side of the square for the king, who was to preside in person; and around him were seats where, nearest to the king, sat the members of the royal family, and on either side of these the courtiers with their wives and daughters.

The king arose and called the first name on his list. A young man pale with the studying of all the old arithmetic books he could find, stepped forward before the throne. Then the king read slowly the following:

"What is the square of the cube root of the logarithm of the sine of 45°?"

The pale young man looked paler still and trembled visibly. He knew what a square was; he thought he knew what a cube root was; he remembered indistinctly having heard once of a logarithm; but a sine— "Twenty-five," he cried in desperation.

"Wrong," answered the king sternly, and called upon the next contestant.

The next man knew nothing about any of these

terms, but thinking that the pale youth was apt to know a little more than he, said twenty-six. The next answered twenty-four, and the fourth, seeing that his predecessors were evidently not on the track at all, guessed one thousand. And thus it went for three long weary hours, at the end of which the king and the spectators were showing evident signs of weariness. —

At last the king called the name of the court mathematician's ex-pupil.

Just a moment before this, however, a messenger in the royal livery, who had been sent the previous day to search for a young man answering to the description of the court mathematician's ex-pupil, and who had forgotten all about his commission until a few minutes before, hastened up to the young man and gave him a note written on delicate, violet-scented paper. Ferdinand had just glanced at it when he heard his name called. This is what he had read :—

Stupid youth, do you not understand what is meant by the third finest jewel in King Adolphus' crown? What else but his third daughter, the most unfortunate Elsa? If the words you spoke in the garden were not utterly false, you will be at the little postern gate on the east wing of the palace to-night at midnight.   E.

Ferdinand, dazzled by the contents of the note, stepped forward mechanically, and made the custom-ary obeisance before the throne. The time of the meeting proposed by Princess Elsa had passed, but he did not think of that. He only thought of the power he had to gain the prize that King Adolphus

had offered. To be the husband of a princess, son-in-law of a king — this lay in his power! Then he throught of Angelina and how she had put her arms about his neck, and he thanked the princess for her information.

He was brought to his senses by hearing the wearied voice of King Adolphus, who was thoroughly tired of the whole proceeding and about come to the point of telling the next contestant to give the correct answer or be beheaded, droning for the hundred and fifty-fourth time, "What is the square of the cube root of the logarithm of the sine of 45°?"

The ex-pupil of the court mathematician looked at the Princess Elsa, who, all unconscious of the mischief she was causing, returned his glance with a well-affected look of reproach and supplication.

"One and nine thousand seven hundred and thirty — " He paused and looked at Angelina, whose soft gray eyes were fixed intently upon him; "two ten-thousandths," he finished doggedly.

"Wrong!" cried the king angrily, and called the next name.

"One and nine thousand seven hundred and thirty-three ten-thousandths," answered the next man, shrewdly.

"Wrong again," cried the king, still more petulantly. "You did n't come as near to it as he did."

The next contestant did not know the difference between mathematics and geology, yet, strange to say, he replied without hesitation, "One and nine thousand seven hundred and thirty-one ten-thousandths."

"Right at last!" cried the king, gleefully. "Kneel, my friend, and receive your prize;" and the man

knelt on the steps of the throne, while the wearied multitude applauded wildly.

Now, as Ferdinand knew, the successful contestant was a middle-aged man with a wife and seven children, and he smiled, in spite of the bitterness of his disappointment, to think of the disposition he would make of his prize, — for it was a capital offence in Nunvalia to refuse the gift of the king.

Imagine then his surprise and rage when he saw in King Adolphus' extended hand the ruby.

For a moment he stood confounded. Then he pushed his way through the throng, and throwing himself before the throne, cried that he had a boon to ask.

"State it," said the king good-naturedlly, and withdrawing his hand.

"Your majesty, I dispute the computation of the court mathematician, and maintain that the square of the cube root of the logarithm of the sine of 45° is 1.9732."

The king frowned.

"Listen, your highness," continued Ferdinand. "I do not wish to regain the ruby. But I love the court mathematician's daughter. Grant that if I can prove him in error he shall give her to me in marriage, and if I am shown to be wrong I promise to pay for my boldness with my head."

The king gladly consented to this proposal. The prospect of enjoying a beheading, a luxury which his advanced notions of the function of a king had not allowed him for a long time, appealed very strongly to his not yet entirely civilized and moralized nature. He therefore called forth the court mathematician, and the discussion began.

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But the king soon repented of his action. For he could not understand a word which either disputant uttered; nor could his wise men nor any of his court any better than he; neither indeed could the court mathematician understand his pupil, nor on the other hand could the pupil understand the court mathematician; and therefore the discussion went on for almost an hour, now purely argumentatively, and now becoming heated almost to the point of personal recrimination and blows, and now again subsiding into the persuasive; until at last the king, being able to stand it no longer, jumped to his feet and was about to cry, "To the block with both of them." Just then his youngest daughter, the Princess Elsa, laid her hand on his sleeve.

Now the Princess Elsa, who was a tender-hearted maid in spite of her occasional pranks, had seen the mischief that she had unwittingly done, and had determined to make amends for it if possible.

When King Adolphus saw her standing at his side, he put off uttering his dire command, and leaned over to hear what she had to say. Then gradually the stern look on his face became mollified, and bidding the princess be seated, he thus addressed the court mathematician and his ex-pupil, —

"It is evident that this point cannot be settled by dispute, and that it will be necessary for each to give away a little to the other. This is the compromise which the Princess Elsa, my daughter, suggests, and which I now command to be carried out. You" (addressing the ex-pupil) "shall acknowledge that the square of the cube root of the logarithm of the sine of 45° is 1.9731; this will satisfy the court mathe-

matician, and being a young man you ought to know that you must be wrong anyway. And you " (addressing the court mathematician) " shall give your daughter to your former pupil; and I will say that being an old man you should have known better than to try to hinder the course of true love. Thus will we follow our old maxim which says, ' Honor shall be given to old age, and to the youth his sweetheart.' And," added the enlightened king of Nunvalia, smiling, " since it is impossible to tell just what is the square of the cube root of the logarithm of the sine of 45°, I will keep the ruby myself, and have it reset in my crown."

That night, as Ferdinand was wending his way through the royal gardens toward the place of rendezvous with his beloved, he was stopped by a man who gave into his hands a packet and then hastened away. Ferdinand opened the packet, and within found a beautiful little casket of gold and mother-of-pearl, and inside the casket a ruby, — none other than the one which had been the third jewel in worth in the crown of the king of Nunvalia. And he found in the casket also a little bit of pasteboard, upon which was written, in the same hand as was the note he had received in the afternoon, these words : " If you love a girl, look upon no other, serve no other, *trust* no other."

The ruby the ex-pupil of the court mathematician afterward sold, and he and his beautiful wife lived on the proceeds of its sale all their life long. The casket he gave to Angelina that very evening. But the card — he did not.