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Is it possible to cry a river?

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Abstract
This paper investigates whether someone would be able to cry a river, based on a flow rate from the world's shortest river (the Roe River). Additionally, the number of tears per person that would be required to fill an Olympic size swimming pool was investigated. The paper finds that the whole population of the Earth would be unable to cry the Roe River and in order to fill the pool 55 tears per person would be required.

Introduction
The title and lyric "Cry Me A River", from the song written by Arthur Hamilton (see also the eponymous Justin Timberlake song) has gone on to become a widely-used put-down phrase in the English language. Hamilton stated that he meant the phrase as a "smart retort to somebody who had hurt your feelings or broken your heart" [1], but nobody yet has determined whether an unrequited love would be able to reproduce a river's flow rate in tears.

Crying a River
Assumptions
In order to model this situation, we decided to use the shortest river on Earth. According to the 1989 Guinness Book of World Records, the world's shortest river is the Roe River in Montana, at 61m [2]. The river was chosen as the basis for the calculations as it was assumed to have a low volume while maintaining the title of 'river' and having a characteristic flow rate; while other rivers may be slower-moving, the volume of water also impacts the flow rate.

It was decided that in order to cry a river the best way to model it would be to use the amount of water that flows through it in a day. The Roe River is known to discharge between 156-193 million gallons per day [3, 4]. If we take the lower estimate (156 million gallons per day) as this is the most achievable target, it equates to 709,190,040 litres per day. Previous research has shown that an average tear flow is 1.2 µL min^{-1}, equivalent to 1,728 µL day^{-1} [5].

It was assumed that no water was evaporated or absorbed by any surface.

Calculation
By dividing the number of litres discharged per day by the average tear flow rate it allows the number of people that would be able to cry a river to be found:

$$\frac{709190040\ L\ day^{-1}}{1728\ \times\ 10^{-6}\ L\ day^{-1}} = 41\ \times\ 10^{10}$$

Considering that the Earth's population at the time of writing is 7.408 x 10^9 [6], we find that not even the population of the world would be able to cry the Roe River.

Crying a Body of Water
Assumptions
As the calculation above shows, it would be impossible for human tears to recreate the flow rate of even the smallest river. We therefore went on to investigate how long it would take for a set volume of water to be produced by the tears of the global population combined.

A previous study calculated the average volume of a single human tear to be 6.2 µL [5]. The population of the Earth, as stated earlier, is 7.408 x 10^9 people. The body of water chosen was an Olympic-size swimming pool, which measures 50m x 25m x 2m – equivalent to 2,500,000 L [7].

Calculations

By using the population of the Earth and multiplying this by the volume of a tear, the volume produced if the global population cried one tear each was found:

$$6.2\ \mu L\ \times\ 7.408 \times 10^9 = 45{,}930\ L$$

Using this, the number of tears per person that it would take to fill the Olympic-size swimming pool could be found:

$$\frac{2{,}500{,}000\ L}{45{,}930\ L} = 54.43$$

Therefore, to fill an Olympic swimming pool the population of the Earth would need to cry 55 tears each. This is therefore clearly not an effective means of filling a body of water.

Conclusion

This paper shows that Arthur Hamilton would be sorely disappointed if he expected someone to respond to his suggestion of crying a river, as the whole world's tears would not be able to produce a flow rate equivalent to that of the shortest river. However, he may find solace in that if the Earth's population was moved strongly enough, an Olympic-size swimming pool of tears could be produced.

In all likelihood, a human would not be able to cry for a whole day without replenishing the water in their body or simply exhausting themselves.

References

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