BY ALAN GOLDBERG

Four Play

THIS ISSUE'S PUZZLES

1. Four Cubes. A small rectangular aquarium had a base of "a" square inches and was partially filled with "i" inches of water. Four six-inch cubes were then placed on the bottom (not stacked), one at a time. The water level increased by 1 inch when the first cube was inserted; further increased by some unknown amount when the second cube was placed inside; and by one and one-half inches each for the third and fourth cubes. What was the water level after the fourth cube was inserted? This is a modification of a puzzle submitted by Bill Graham.

2. A Pair of Fours. South, declarer at 6 notrump, needs four more tricks to make the slam. Can South succeed with the hands shown below? What is the result if East's ♦ 4 is changed to the ♣4. This doubleheader is a modification of a problem posed by David McCann.

	♠ — ♥ Q 3 2 ♦ Q ♣ 3 **NORTH**	
♠ 7 5 ♥ J 5 ♦ — ♣ Q	**WEST**	**EAST** ♠ 9 6 ♥ 8 7 ♦ 4 ♣ —
	SOUTH ♠ J 8 ♥ 9 6 ♦ 3 ♣ —	

			c			
	f		u		v	
	o		a		i	v
q	u	a	t	r	e	
	r		r		r	
			o			

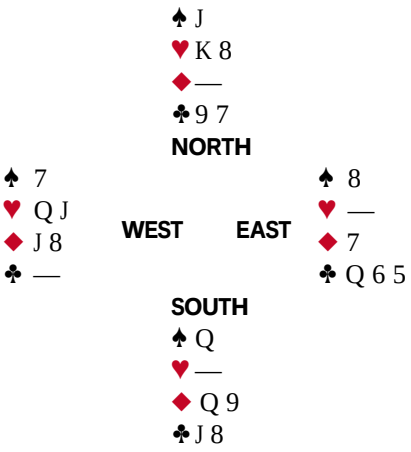
ANSWERS TO LAST ISSUE'S PUZZLES

1. Bath Time. Before starting to run bath water for the kids, the tub was already half-full and the water temperature was 84°. I turned on both the hot and cold-water tap. The hot water runs at 135° and would provide a full tub in 6⅔ minutes. The cold water runs at 80° and would provide a full tub in 8 minutes. Unfortunately the stopper was not in place and the water was draining at a rate of 13⅓ minutes for a full tub. With both hot and cold taps running and the tub draining, how long will it take to fill the tub? Assuming the incoming water mixes instantly with the water already in the tub, what will the water temperature be when the bath is ready.

THE ANSWER IS: The bath will be ready in 2½ minutes and the water temperature a moderate 100°. Per second, the hot-water tap fills 1/400 of a tub; the cold, 1/480; and the drain empties 1/800 of a tub. Combined, the tub fills at a rate of 1/150 per second, so it takes 2½ minutes for the bath to be ready. The temperature of the incoming water will be a mix of 135° and 80°; the temperature of the draining water will constantly change and the final temperature is dependent on the amount of original water remaining. Let r(t) be the amount of original water remaining at time t. The solution requires differential equations and only a brief outline of the solution follows. The rate of change in r is dependent on the proportion of r to the total in the tub at time t. Thus: $dr(t)/dt = -.075 \times r(t)/(.5+.2t)$ where .075 is the drain rate, .5 the starting level of original

water, and .2 net rate of inflow over outflow. Using integration by parts leads to r(t) = .5 x 1/(1+.4t)^.375 and r(2.5) = .3856. The combination of .3856 of a tub at 84° and the balance at the mix of hot and cold leads to the final temperature of about 100°. One solver, J. Krull, avoided integration by parts by rearranging the equation before integrating. The bath's ready, please pass the soap.

2. Seesaw. South, declarer on lead at 4♠, needs four more tricks to make the contract. If she plays her cards right, can she make her game? Here's the hand, a modification of a problem posed by David McCann:



THE ANSWER IS: South draws trump and leads the ♣ J; and the "seesaw" begins. If West discards a diamond, the ♣ 9 is unblocked which forces East to allow the declarer a club entry to cash two diamond tricks. If West discards a heart, dummy follows with the ♣7 giving East a choice of two losing plays. If East wins this trick, the forced club return gives dummy the last two tricks. If East ducks, declarer switches to the ♦ Q followed by the ♦ 9. This puts West on lead to give the dummy the last trick in hearts. Some solvers led the ♦ Q after drawing trump; this was also a correct solution but missed the fun of a ride on the seesaw.

Solvers (March/April): H.N. Crooks, Mark Evans, L. Helfgott, J. Israel, R. Koch, D. Promislow, J. Reinbolt, D. Skurnick, Y. Starr, R.C. Stokes, S.L. White, R. Wilton.

Editor's note: These were particularly difficult puzzles. I tip my hat to J. Israel whose early response enabled me to catch an error I had made, and to D. Promislow who introduced me to "The Polya Theory of Counting"—a method which makes Painting the Cube easy. Where n is the number of colors, the answers are given by $(n^6 + 3n^4 + 12n^3 + 8n^2)/24$.

Solvers (May/June): E. Arvanitis, M. Barsky, R. Bergstrom, S. Berman, K. Bitu, Yuan Chang, D. Doddridge, J.J. Doucette, Mark Evans, R. Goldthrope, D. Harms, L.K. Helfgott, Thomas Herzog, H. Ingraham, F. Karlinski, D. Kidwell, R. Koch, J. Krull, D. Llewellyn, A.&R. Malasky, D. Runkel, J. Russ, D. Sachs, T. Shively, D Skurnick, W. Sohn, Y. Starr, W. Steffen, R.C. Stokes, W. Ulrick, J. Varca, R. Wilton.

PLEASE MAIL ALL ANSWERS TO ALAN GOLDBERG, PUZZLES EDITOR, 303 BLUE RIDGE ROAD, LOUISVILLE, KY 40223; OR E-MAIL TO CONTPUZZLE@AOL.COM; OR FAX TO (502) 245-5260. THE NAMES OF THOSE WHO SEND CORRECT SOLUTIONS WILL BE ACKNOWLEDGED IN A FUTURE ISSUE OF *CONTINGENCIES*.