LOGICAL DIVINATION

By Jeremiah Farrell

This mathematical magic is dedicated to Raymond Smullyan who was an inspiration to us all.

The Effect. From a shuffled deck of 52 cards the subject secretly selects a single card and after looking at it places it face down on the table.

The subject now privately selects one of these three quirks:

      (1) To be constantly truthful
      (2) To be constantly lying
      (3) To alternate between the two.

The magician says "I am going to ask you eight simple Yes-No questions about your chosen card. Please answer all of them according to your quirk. Four will concern your suit and four will concern your denomination."
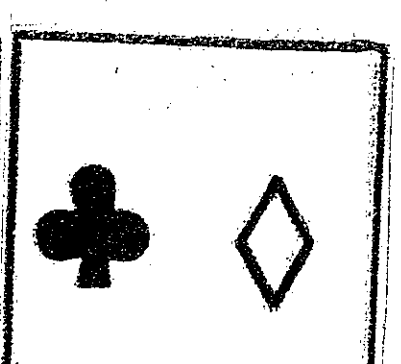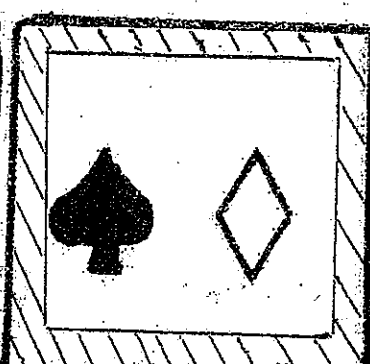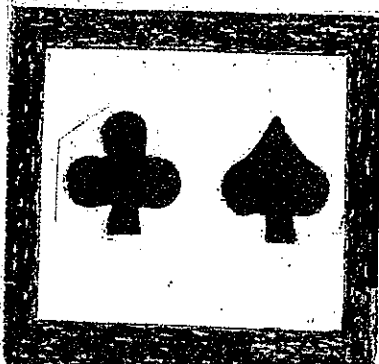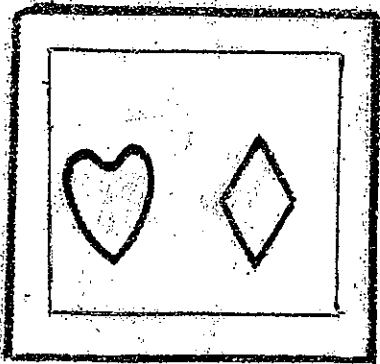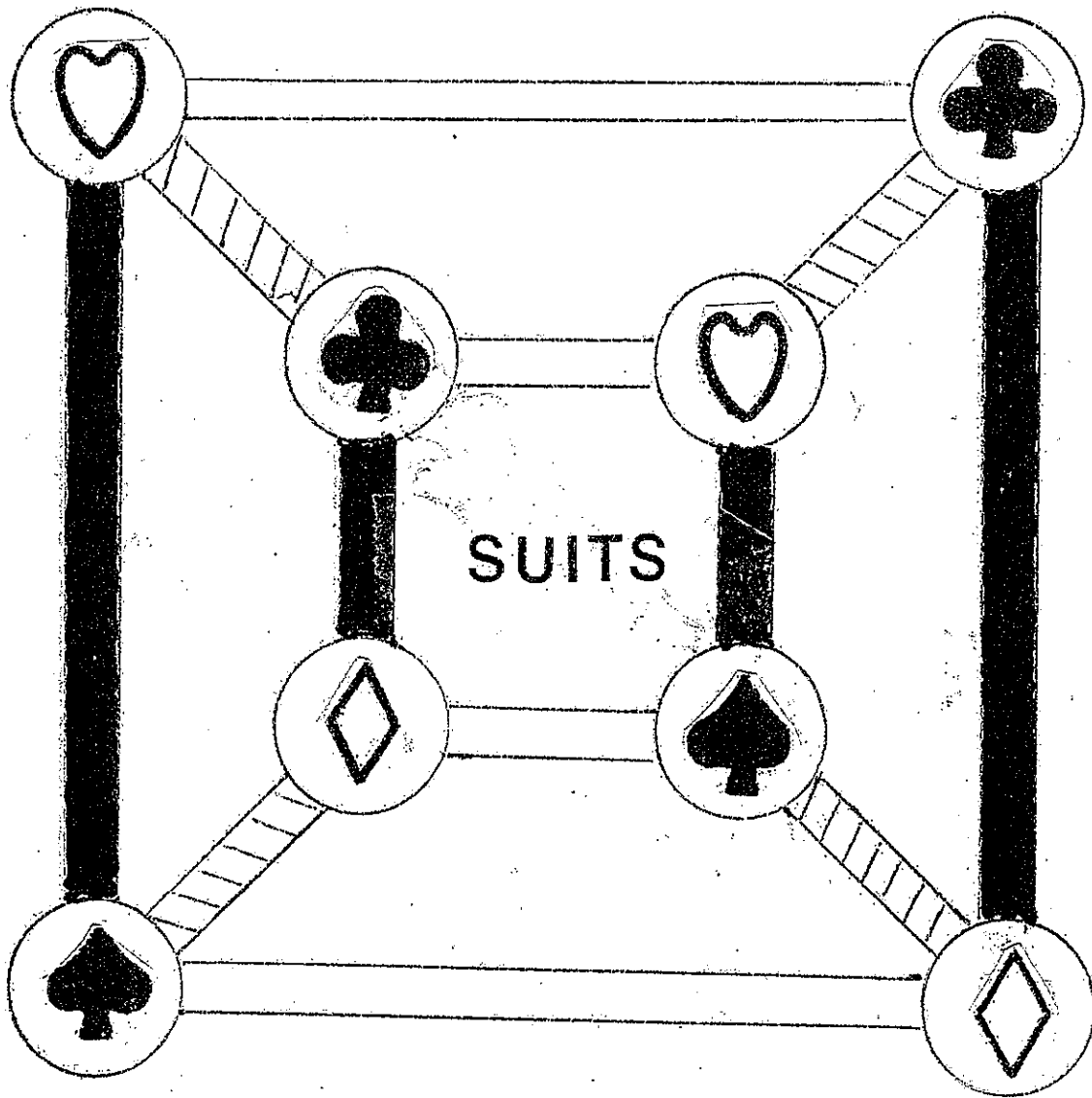
The magician displays the depiction of a cube and four 2-sided cards with suits marked on them. "Please turn the cards up on one side or the other, entirely your choice." "I now ask four questions to be answered according to your quirk." The questions will be "Is your suit here?" The magician points to each card in turn and asks "Is your suit here?" He then proceeds to the four circles with denominations on them.
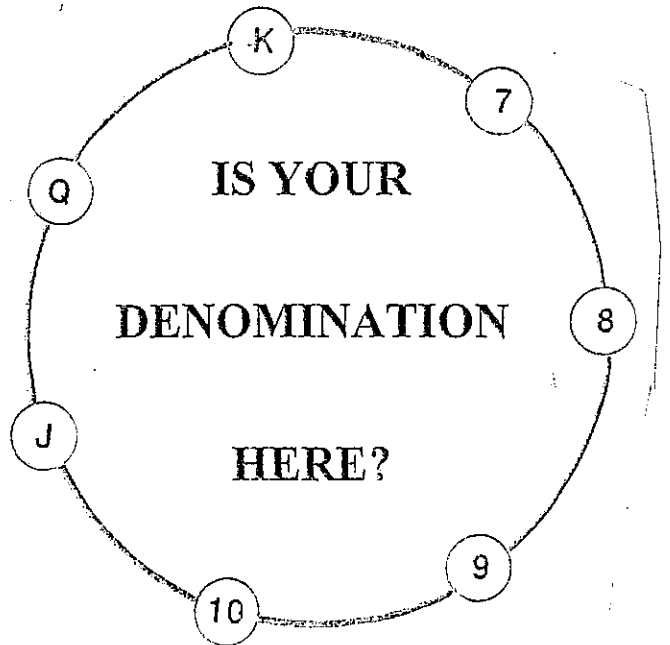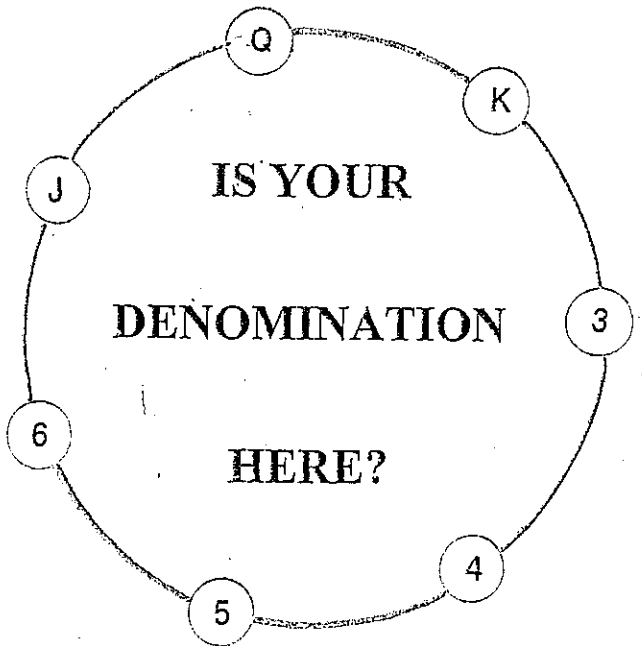
"Continuing exactly with your quirk, point to a circle and ask the question on it." This is repeated until all four circles are addressed.

The magician is now able to correctly name the chosen card.

As an example on the two diagrams that follow, suppose the subject chooses to place face up the four cards shown, has selected the 3 of spades and chooses to alternate starting with a lie. Therefore, he will answer lie, truth, lie, truth, lie, truth, lie, truth. The subject's answers to the four cards in order shown will thus be Yes, Yes, No, No. And to the four circles in left to right, top then bottom will be Yes No, No, No.

Can you decifer how this combination of Yes-No answers points to the 3 of spades? The technique is quite straightforward.

SUITS

Circle 1 (top left): 4, 6, A, 8, K, 10, J

IS YOUR DENOMINATION HERE?

Circle 2 (top right): 9, 10, 6, Q, 5, K, 2

IS YOUR DENOMINATION HERE?

Circle 3 (bottom left): Q, K, J, 3, 6, 4, 5

IS YOUR DENOMINATION HERE?

Circle 4 (bottom right): K, 7, Q, 8, J, 9, 10

IS YOUR DENOMINATION HERE?
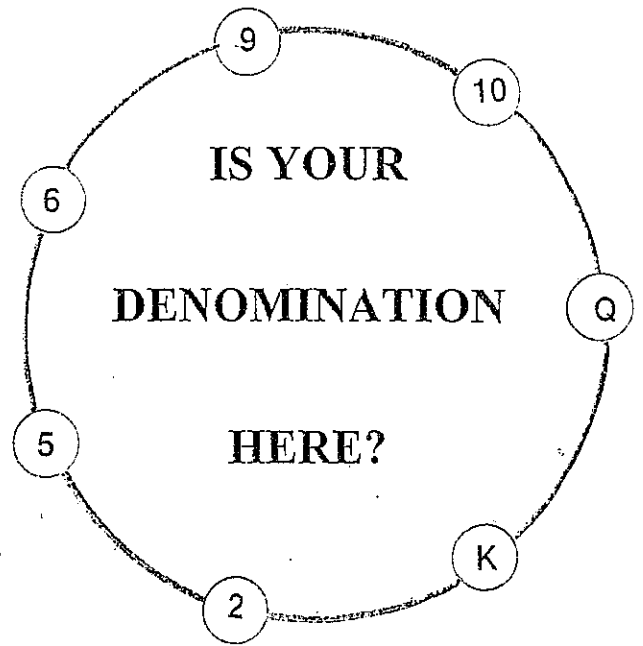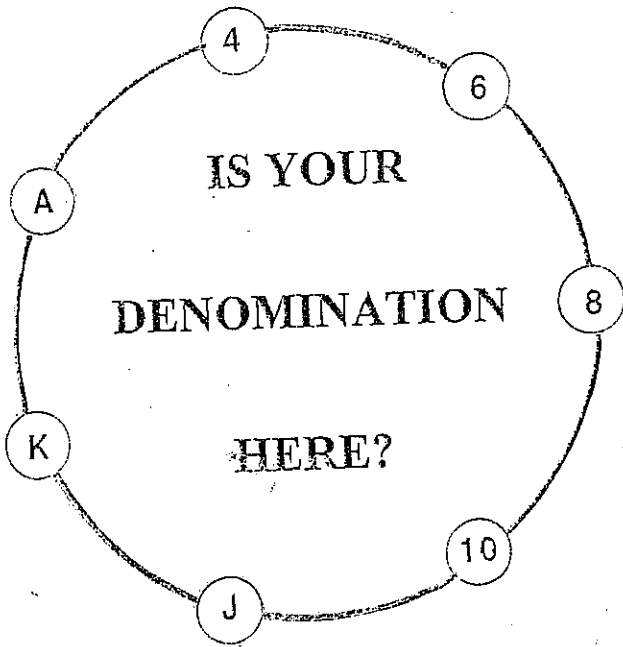
The Explanation. After the four answers are given to the suit questions, the magician will know the chosen suit and also the subject's quirk. On the large outer square in the diagram the main diagonal heart, club, spade and diamond will represent all lie or all truth on the suits. The off diagonal club, heart, diamond and spade will represent an alternate quirk starting with either a lie or a truth.

It is important to ask the four questions in the order shown because of the alternate quirk. This order is represented here with front and back of the cards.

HORIZONTAL   VERTICAL   HALF DIAGONALS   SKIP DIAGONALS
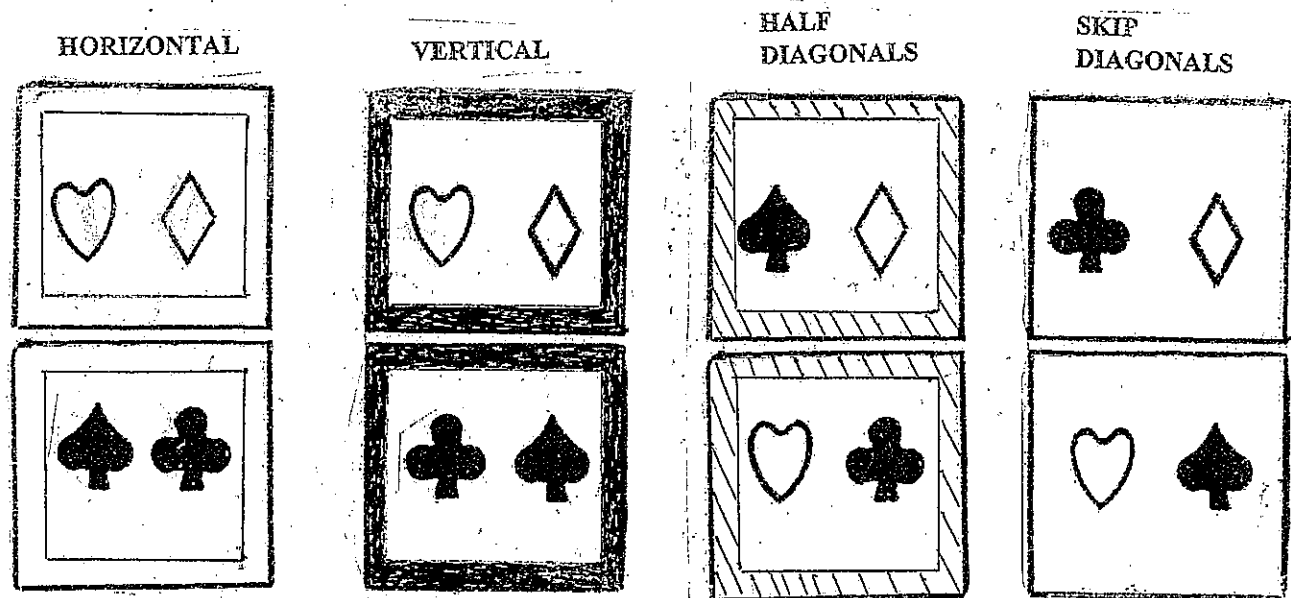
The above arrangement forces a key of diamonds on the main diagonal. Any time a suit appears four times either on front or back, that suit will be key and appear on the main diagonal. The key on our example has changed by flipping the second, solid edge card and becomes a club key on the off diagonal. Any other flips locate a new key by tracing more marked edges. The fourth card with unmarked edges is traced on the diagram by a diagonal hop which will jump hearts and spades, the majors, or diamonds and clubs, the minors.

Another Example. Always start to trace on the key. Suppose the key is diamond on the main diagonal and we get the order of the tops of the above cards. For the quirks all true or all lies we end on diamond if the card was a diamond and we know the subject's quirk by the response to the last question. But suppose diamonds is the suit and alternate is chosen with a lie start. The responses would be No, Yes, No, Yes and a trace of the two Yeses from our key ends on the diamond in the off diagonal. Because it ends on the off diagonal we know the suit and the quirk must alternate and the last answer was truth so we know the four remaining denominations will go False, True, False, True.

Another Example with a Diamond Key. Suppose the suit is hearts. With a true quirk the answers will be Yes, Yes, No, No ending on main diagonal heart with last answer correct so the subject's quirk is all true If an all false quirk, the answers will be No, No, Yes, Yes on heart again and now known to be a liar. The reader may trace either alternate and note the ending on heart on the off diagonal.

For the denomination, since the magician now knows the subject's quirk, he points to the circles in any order and quickly determines which circles get actual true responses of Yes. The circles each have a smallest number, the ace (one), two, three and seven. The correct denomination will be the sum of all low numbers for the correct Yes responses.

After practice it is not necessary to place the four cards in order for the suits. Instead the subject can do this and the magician can point to the cards in order and ask "Is your suit here?" For the denominations the magician can ask the subject to choose the order.

There are $2^8 = 256$ responses possible to the eight questions and since each of the suits in the diagram does double duty, the diagram really represents a 4-dimensional cube with 16 nodes. Similarly for the denominations.

It was my great pleasure to have known Raymond Smullyan for almost 25 years, always through the G4G. He was a complete delight. How often did I listen to him play classical pieces on the piano at the Gatherings – mostly during lunch hours. I regarded him still as a superb virtuouso.

I remember my former Butler colleague, James P. Fink, running with glee to meet Raymond at the 7th Gathering. Fink recently told me "Yes, it was an honor to meet Smullyan in person. He sat in front of Patti and me on the bus ride to the marvelous Japanese dinner at Tom Rodgers' beautiful house, and I had a chance to chat with him."

Smullyan was ever kind and generous with all of us. At the fourth Gathering I gave a talk where I, for one reason or another, called people who always told the truth convivial and those who always lied contrary. Raymond gently took me aside and suggested that I simply call them truth-tellers and liars to conform to common usage. One of my handouts at G4G13 will be a paper "Logical Divination" dedicated to him and using his suggestions.

My friend, Rochelle Kronzek, of World Scientific Publishing and I talk often about Smullyan's puzzles, and she asked me to review one of his manuscripts. Who would turn this down?