Think It Over

This section of* Resonance *is meant to raise thought-provoking, interesting, or just plain brain-teasing questions every month, and discuss answers a few months later. Readers are welcome to send in suggestions for such questions, solutions to questions already posed, comments on the solutions discussed in the journal, etc. to* Resonance *Indian Academy of Sciences, Bangalore 560 080, with "Think It Over" written on the cover or card to help us sort the correspondence. Due to limitations of space, it may not be possible to use all the material received. However, the coordinators of this section (currently A Sitaram and R Nityananda) will try and select items which best illustrate various ideas and concepts, for inclusion in this section.

From B Bagchi, Indian Statistical Institute, Bangalore.

1 Customers in Book Exhibition

The reader is warned that though the problem looks very simple, the solution may not be easy! However, the reader is encouraged to try this problem seriously.

There was a big crowd of customers in a book exhibition. It turned out that for any two of the books on display, there was a unique customer who wanted these two books (and possibly more). However, no customer wanted all the books. Can you decide if there were more books or more customers?

From V Rajaraman, Indian Institute of Science

2 Self-Copying Program

Can you write a program in C which prints its own source code? How about writing such a program in other languages like Fortran?

3 The Population Explosion

R Nityananda, Raman Research Institute, Bangalore

Discussion of questions raised in **Resonance** *Vol.1, No.1.*

We have received reactions from readers which suggest different errors in the reasoning which led to the idea of a population explosion in the past. Summarising, the basic error is in the assumption that all the 2^n ancestors which one person had n generations ago are 2^n distinct people. To see this in an extreme example, it is recorded that the ancient Egyptian royal families would have brother-sister marriages for several generations. In this case, any member would have only two ancestors no matter how many generations one went back. In modern societies, of course, the relationship (of having common ancestors) between a couple who marry is naturally more distant. But even in the case of one's parents being first cousins (not rare in some parts of our country) the number of great grandparents is reduced from eight to six. The real surprise is that this effect *must* operate. Even in cases where one thinks that two of one's ancestors were unrelated, if one goes back far enough they in turn have common ancestors, so one is always overcounting!

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4 A Question of Weight

R Nityananda, Raman Research Institute, Bangalore

The question regarding the measured weight of a box containing a bird provoked readers into different responses. When the bird sits in equilibrium at the bottom of the box, we would all agree that its weight is registered. The bottom of the box clearly exerts an upward force on the bird, counteracting its weight. Correspondingly, the feet of the bird push down by an equal amount (Newton's third law). What is interesting is that a similar reasoning applies even when the bird is in level flight. The weight of the bird must be counteracted by an extra pressure difference between the lower and upper surface of its wings (and body). How this difference is generated by the bird flapping its wings is a complicated matter. But we know, since the bird is not falling, that the air must be holding it up. In turn, this extra pressure gets transmitted to the

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bottom of the box and shows up in the measured weight. The same reasoning applies even when the bird is falling with constant (terminal) velocity. Since there is no acceleration, the forces on the bird are balanced.

We leave it to our readers to now convince themselves that when the bird is falling with an acceleration g (i.e. neglecting air resistance) its weight is *not* registered. During the period when it is coming to rest after striking the bottom of the box, the bird is decelerating. The balance shows *more than* the weight of box plus bird (which is one reason why one should not jump on weighing machines).

Clash of the titans ... The first encounter between the two eminent theoretical physicists, Wolfgang Pauli, then a young man, and Paul Ehrenfest, who was already reputed, is an amusing story. Ehrenfest is supposed to have told Pauli: "I like your papers better than you". Pauli's answer: "That is strange, because I like you better than your papers".

Optical illusion ...