GATE SYMBOLS

May I ask for guidance through your columns as to what logic symbol is appropriate to indicate the function of the following circuit?

This gives an output only when one of the inputs is in the opposite logic state to the other two, and should thus, I presume, be called a Disparity Gate. The truth table is as shown

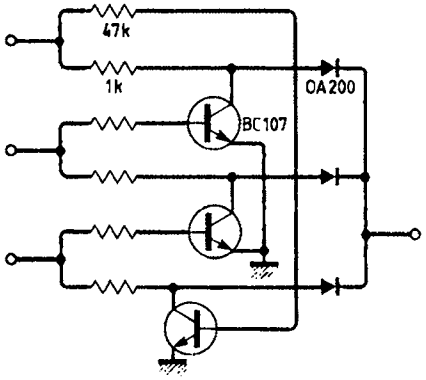
Inputs	Output
All 0	0
One as 1	1
Two as 1	1
All 1	0

When the new logic symbol pundits have worked out that one there is an elaboration of this circuit that can convert it into a Two out of Three Quorum Gate* which has the additional property of being exclusive.

Power supply? Anyone who has not been ordered to design circuitry without any power supply specified doesn't know what if feels like to be an electronic engineer!

J. C. Rudge
Harlington,
Middlesex

*J. C. Rudge (letter) Wireless World, July 1982.



INPUTS	OUTPUT
All 0	0
One as 1	1
Two as 1	1
All 1	0

HERETIC'S GUIDE TO MODERN PHYSICS

In his May article, Dr Scott Murray is yet again guilty of the inexcusable – misquoting facts out of context. This was blatantly manifested when he used Dirac's postulation of the positron as a pretext to an attack on the tunnel effect, despite the fact that there is no connection between the two.

Dirac's calculations had a square root in the result for the charge of electrons. This allowed them to have either negative charge-electrons, or positive charge-positons. Dirac predicted the existence of 'negative matter, in the sense that its constituent particles were oppositely charged, and so the term 'anti-matter' was coined. Dirac never suggested that positrons had negative mass. He did not have to 'explain' the positron; his mathematics predicted it and physics later confirmed its existence. Dr Murray appears to have confused the positron with its negative-mass 'cousin', the hole. The holes are gaps in a free electronic continuum, and in that context only can you have positively charged particles with negative mass.

In conclusion, Dirac's antimatter concept may appear in some science fiction, but it is very much science fact. Dr Murray's use of this, misquoted out of context and in any case totally irrelevant, is a very poor attempt to mislead gullible readers.

M. J. Niman
Manchester

In the May issue a number of letters critical of Dr Scott-Murray's long-running saga 'A Heretic's guide to modern physics' appeared. In commenting on mine Dr Murray wisely sidestepped the first two paragraphs and concentrated on the third. A number of ideas which were current half a century ago have not stood the test of time, and the notion of duality is certainly one of them. In a preceding, so far unpublished, letter I emphasized that 'quantum objects' such as photons and electrons were neither waves nor particles, exactly the point made by Mr Gleave in the May letters. Nevertheless Dr Murray in his first comment on my letter chose to flagrantly misrepresent me by stating that I had written as if 'light *is* both (particle and wave) simultaneously'.

In this context a feature not brought out by Mr Gleave is the fact that quantum mechanics provides a single mathematical description of photon behaviour which covers not only the quasi-particle and quasi-wave aspects, but in addition the in-between world typified by the remarkable kinds of behaviour shown in some types of Mössbauer experiments. Originally Planck and Einstein attributed properties to photons in an essentially *ad hoc* fashion, but for some decades now theoretical accounts of behaviour have been available (see Heitler's 'Quantum Theory of Radiation') which show that they must be regarded as behaving in a way far removed from the billiard-ball-like objects of Dr Murray's imaginings.

In the unpublished letter I also pointed out that the spectra of gamma rays from radioactive sources obtained using Ge(Li) detectors regularly showed features indicating that over a microsecond or so any bunching was less by some orders of magnitude than the millions which Dr Murray in his October article said he would settle for, yet that these gamma rays still showed interference effects, in that their energies (or wavelengths) could be determined by passing them through a quartz crystal acting as a diffracting grating. These facts too he felt entitled to ignore.

Turning to his second comment, I must first admit some order of magnitude difficulties of my own: a photon of visible light has a wavelength, not of some tens, but of some thousands of interatomic spacings. He asked in connection with the optical photo-electric effect 'why is it that only one of these (millions of) electrons is ejected by the photon's impact?'. The answer is simple – on the purely classical basis of the image force between a charge and a conductor it will take a finite amount of energy to remove even a conduction electron from a metal. Photons of visible light simply do not have enough energy to remove more than one conduction electron from alkali metals such as sodium and potassium.

He went on to ask 'what physical mechanism determines *which* electron is ejected, and 'how wide is a photon, please?' Now Doppler shift measurements show that the conduction electrons in metals have speeds of about 0.1% of the speed of light, some ten times the value to be expected from classical theory, but fully in agreement with the predictions of wave mechanics. If one assumes that the delay between a photon hitting the surface of a metal and any subsequent emission of a photoelectron is of the order of 1 ps, a typical conduction electron will in that time have travelled some thousands of times the average distance between neighbouring atoms, so that willynilly the photon will have interacted with electrons over an area comparable with the square of its wavelength. These same conduction electrons have De Broglie wavelengths of several interatomic distances, and according to wave mechanics this is the feature which allows them to move freely about in metals. Dr Murray really should try his hand at using his ideas to account for, say, the temperature dependence of the resistance of metals at liquid helium temperatures. Although no-one would realize the fact from reading his articles, it was the success of wave mechanics in interpreting this dependence and many other puzzling aspects of the behaviour of solid materials that first persuaded many physicists to consider the new theories seriously.

C. F. Coleman
Grove
Oxfordshire

Abstract Law is just as unbreakable in Copenhagen as anywhere else!

I have already touched briefly upon the law of pressure, resistance and flow: another is the law of decay from interaction.

The further interaction is reduced, the less decay there is. Insulators attempt to stop interaction, and they succeed more or less. There is not, nor can there ever be a perfect insulator, and any perfectly insulated device would be an absolute singularity having nothing to interact *with*: needless to say, there is one, and one only, and you are in it up to the eyes and beyond!

For these reasons, no potential barrier can be absolute, and I could not really care a tinker's cuss how electrons manage to get past it, though I am happy to hazard a guess (based upon the same deductive logic which says that energy exists) that there is a massive carrier in apparently empty space through which energetic interaction occurs.

Thus, while I positively adore Dr Scott Murray, it seems to me that his subjective arguments are so shallow and superficial that they merely invite argument from the specialists of this world: the drops in the ocean may be seen as particles in motion, and it takes one particle an impossible amount of work to make a wave.

What is all the fuss about? Rubbing the nose of a mess-maker in his mess merely makes him argue. Let them stew in it: make the prognosis, and let time prove it.

Dirac and Bohr must come to accept that space is not empty: it just appears that way because you can't catch a basic building block! There is nothing smaller with which an adequate mesh can be made, so that it inevitably slips through the holes.

It is a simple matter of inter-disciplinary analysis of which the single discipline specialist is mentally incapable. Farm the blighters!

James A. MacHarg
Wooler
Northumberland

LETTERS

In *Wireless World* of April 1983, p.48, Jones gives an impressive list of oversights and omissions which were present in the interpretation of the Michelson and Morley experiment. However, I missed one important problem I have always felt when dealing with this problem.

In this experiment it is always taken for granted that the velocity of light does not change at reflection. However, how can one be sure about that? Apart from Romer and similar determinations of the velocity of light I do not know of any other way of determining the velocity of light, thus without mirrors and lenses. On the contrary, from the point of view of light as a stream of photons it is at least just as likely that light might change its velocity at reflection: if a photon excites an electron which on its turn produces another photon there is no reason why the velocity of light of the original photon should be the same as the newly created one. But if the velocity of light may change at reflection, already for this reason the experiments of Michelson and Morley cannot produce a difference in the velocity of light (after reflection).

Dr M. Osinga
Haarlem
Netherlands

I was very interested to read M. G. Wellard's letter (January), including his comments on N. Rudakov's book "Fiction Stranger than Truth", which I have also read with considerable interest.

Wellard states that Rudakov has collected "more than enough evidence to show that the physics Establishment is in the hands of ideological extremists". It is a little unfortunate that he then goes on to mention, as a sample of that evidence, a somewhat exaggerated statement of Rudakov's. Wellard refers to Rudakov's citation of a review of one of Harold Aspden's books, and repeats Rudakov's assertion that the review says that Aspden is a crackpot. Although the review is somewhat pejorative, it is an exaggeration to say that it calls Aspden a crackpot.

On the same page of his book (p.9), Rudakov writes that "Lyttleton is of the opinion that the truth of relativity seems so self-evident as to be beyond need of discussion by any sane people." Although he does not give the source, he is fairly obviously referring to a letter to *The Times*, which is reproduced on pages 10-11 of Herbert Dingle's book "Science at the Crossroads". A careful reading of the letter shows that what Lyttleton wrote is completely different from what Rudakov attributes to him.

As Rudakov rightly says, (p.7), "Silence is the main weapon of the relativists." There is also ample evidence that members of the scientific community view scientific heretics with scorn and refuse to take their arguments seriously, and I was glad to see Wellard's reference to the scornful heading of an article in *New Scientist*. After perusing the relevant correspondence and seeing the heading "Einstein 6, Cranks 1", the reader may possibly conjure up a picture of Einstein playing golf. Whatever game the writer of the heading had in mind, it certainly was not cricket!

Ian McCausland
University of Toronto
Canada

The principle of indeterminacy is not a topic which I have studied to any great extent, but I would like to put a question to Dr Murray. He argues in your March issue that it is possible to determine what the velocity of an electron *was* "to any accuracy we please". But all electrons look alike. How then can we know whether the electron on which the second observation of position was made is the same as that on which the first observation was made?

K. S. Hall
City University
London

FORTH COMPUTER

In his article on a Forth computer Brian Woodroffe takes the dangerous step of comparing microprocessor c.p.us by preparing a number of examples of small isolated sections of code. Whilst I do not wish to take a standpoint in favour of any particular device I would like to point out that this sort of comparison is, at best, worthless and can be misleading. To quote one counter example, the 8088 '+' operation could be carried out via the instructions

```
POP AX
MOV BP SP
ADD [BP] AX
```

equal to the 6809 in terms of instructions, or, BP has a fixed relation to SP, as is the case in most executing programs,

```
POP AX
ADD [BP + α]  AX
```

where X is an assembly time constant. I hasten to point out that I am not trying to challenge his choice of processor but simply to point out that his reasoning is flawed. I have no doubt that any software engineer (sorry Mr Catt) familiar with the other c.p.u. mentioned could improve upon the quoted examples.

J. O'Connor
Crewe

ELECTROMAGNETIC DOPPLER

In the May issue Mr S. Hobson offers his explanation of e. m. Doppler. His assertion that the mechanism is 'v' is not helpful, 'v' is the cause, a change in frequency is the effect; the mechanism sought is that which links the two. The description he gives for 'wave crests' is equally valid if applied to a string of bullets fired at B by A and in this case the velocity of the bullets as seen by B would be the equivalent of (c-v).

What S. H. does is to divorce the fact that the light travels from A to B from the fact that A and B are moving apart, carefully avoiding describing the resultant composite motion. His final suggestion that v is not velocity but rate of change of distance is playing with words.

The light must leave A and must arrive at B and at each must have an observed velocity, frequency and wavelength which together conform to the equation:

$$v = f\lambda$$

The light leaves A at velocity c. If at B one assumed that it still travels at c relative to A then its velocity relative to B will be c-v. We can write

$$\text{at A} \quad c = f_A\lambda$$
$$\text{at B} \quad c\text{-}v = f_B\lambda$$
$$\text{and} \quad \frac{f_A}{f_B} = c\text{-}v$$

This then is a common-sense description of events which very elegantly produces the right answer but is of course heresy.

If it was not possible by observing the light from a source to tell whether or not the source is moving, one could logically deduce that the motion of light is unaffected by the velocity of the source. As it is possible to tell if a source is moving, then clearly something is affected by movement. If the frequency of a periodic function is lower, then either it is going past more slowly or the 'wave crests' are further apart. If one is not a heretic, light cannot be going slower, therefore the wavelength must have increased. What causes the wavelength to change? Where does the change take place?

Suppose at the moment of measurement B passes a third observer D stationary with respect to A. If the change in frequency observed by B is attributed to a yet unexplained change in wavelength which has occurred at a yet unspecified point between A and B how is it that D does not also observe this change in wavelength. He is at the same point of time and space as B, is observing the same wave as B observes, passing him at the same velocity as it passes B.

Heresy is so much simpler.

J. Kennaugh
Cornwall

Like your correspondent Kennaugh in *Wireless World*, May, 1983 I have been looking at the Doppler theory.

If one considers a particle stream where there is velocity, frequency and separation instead of velocity, frequency and wavelength then the Doppler effects can still be expected.

In calculating the relative velocities of the source and the particles with respect to the observer one can invoke the presence of an 'ether' against which the velocities are measured. These can then be summed to get the relative velocities and to remove the 'ether'. This may at first sight appear to be a pointless exercise but if it is done for an Einsteinian system then it is obvious that for every value of a relative velocity (of the source with respect to the observer) there is an infinite set of pairs of velocities (of each with respect to the 'ether') that produce the same Doppler effect. With a non-Einsteinian system there is only one set of velocities that produces the effect.

The reason for this is that in a non-Einsteinian system the movement of the source produces a change in the velocity and the separation of the particles but not the frequency whereas a movement of the observer produces a change in the velocity and the frequency of the particles but not the separations. Thus the movements of the source and the observer do not cause the same change in the Doppler effect whereas in an einsteinian system they do.

An interesting consequence of this is that in a non-Einsteinian system the universe has built into it a means of identifying which object, source or observer has changed its motion. The contributions of each body to the total relative velocity can thus be calculated.

It would appear, therefore, that some velocities are relative and some absolutely so.

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