50 & 100 YEARS AGO

50 YEARS AGO

A brief review of the history of the calendar by Y. G. Perel suggests the urgent desirability of establishing a world calendar, such as was proposed by India in 1953 before the United Nations. According to this proposal, the year will be divided into four quarters of thirteen weeks each, with the first month of thirty-one days and the following two of thirty days each. An additional day (the day of peace and friendship) is added after December 30, and on leap years an additional day after June 30.

From *Nature* 21 February 1959.

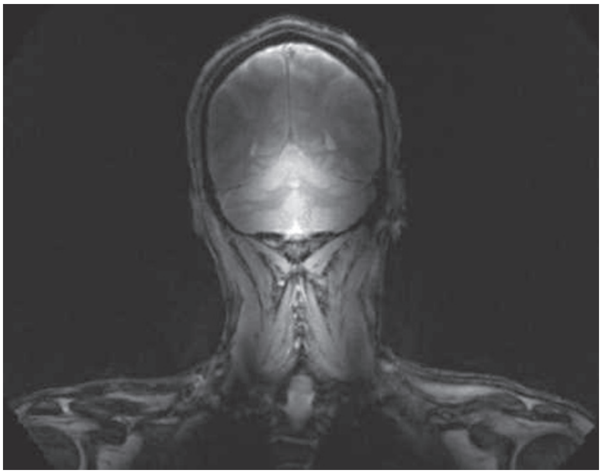
100 YEARS AGO

In this day of encyclopaedias numerous and ponderous, one is often struck with the fact that in spite of the manifest care and conscientious thought bestowed by the responsible editors, the omissions and evidences of discontinuity of treatment, and lack of recognition of the prime purposes of the compilation, are as noteworthy as the imposing array of the results of our steadily advancing knowledge is startling … As an illustration, take the word "research," or any of the associated terms — "discovery," "experiment," "investigation," and "observation." Turning to the index volumes of the ninth and tenth editions of the "Encyclopaedia Britannica," I find but two references in which the word "research" appears — one to the exploring vessel, the *Research*, and the other to "research degrees."

ALSO:

The *Petit Journal* recently asked its readers to select by their votes twelve great Frenchmen worthy of being included in the Pantheon. Pasteur's name appeared at the top of the poll with 315,203 votes, and was followed by that of Gambetta with 279,443 votes. We wonder whether a man of science would head the list if a similar plebiscite were taken by a popular daily paper in this country.

From *Nature* 18 February 1909.



D. BRUNNER & K. PRUESSMANN

Figure 1 | Travelling-wave MRI. Magnetic resonance image of the head and shoulders of a human volunteer obtained by Brunner *et al.*[2] using their travelling-wave MRI technique at a magnetic-field strength of 7 tesla. It demonstrates an impressive extent of coverage for an image obtained at such a high field: most conventional 7-tesla scanners are used for imaging only the brain, but this image shows detailed structure in the brain stem, neck and shoulders.

used to pick up the RF signal generated by nuclei in the body. Brunner and colleagues used this arrangement to record spectra and images from large test samples and the lower leg of a human volunteer. Figure 1 shows an additional image of the head and shoulders. Comparison with images obtained using a conventional RF coil shows that the travelling-wave approach can produce a uniform excitation over a much larger volume (Fig. 4 on page 996).

Until now, methods for moderating the effect of RF inhomogeneity at high magnetic-field strengths have generally focused on using multiple RF coils in parallel[3] for signal excitation. Although this approach shows promise, it is complex and expensive because it requires duplication of costly RF amplifiers and other circuitry. The beauty of Brunner and colleagues' travelling-wave approach, in comparison, lies in its simple implementation and inherently lower cost. In addition, the authors' approach has the advantage of being immediately compatible with all standard MRI techniques.

Although the main motivation of Brunner and colleagues' work is to reduce RF inhomogeneity, their approach has the additional, significant advantage of freeing up space inside the bore of the scanner because it does not require close-fitting RF coils. This extra space is extremely valuable because the cost of the large, superconducting magnets needed for MRI increases rapidly with size. Removal of the RF coil thus opens up the possibility of redesigning the scanner's interior to make it more comfortable for patients and/or to reduce cost.

To reap the benefits of the travelling-wave approach, it is important to minimize the reflection and refraction of radio waves that can occur at boundaries between regions of different wave impedance, such as tissue and air. Brunner *et al.* demonstrate the problems that arise from these effects, but also introduce potential solutions, including the use of wave-impedance matching and absorbers. These involve positioning materials with appropriate electrical properties in the bore of the scanner near to the subject.

The use of waveguides comes with a limitation. These structures can only guide signals whose frequencies are above a certain value, the cut-off frequency, which depends on the diameter of the waveguide (the larger the diameter, the lower the cut-off). This places a lower limit on the size of waveguide that can be used for implementation of the travelling-wave approach. At 7 T, there is a fortuitous conjunction of the required NMR frequency and the frequency cut-off of a waveguide that easily accommodates the human body. Extension of the travelling-wave approach to more commonly available lower-field scanners will require the development of loading arrangements that can reduce the cut-off frequency to encompass lower NMR frequencies.

One potential disadvantage of using the travelling-wave approach for signal detection is that of increased noise pick-up compared with the conventional approach, because the antenna is sensitive to resistive noise sources, such as tissue, or wave absorbers, positioned anywhere in the far field. The high premium placed on the signal-to-noise ratio in MRI means that the optimal technique may involve using the travelling-wave approach for signal excitation and multiple conventional coils for signal detection[4].

Although Brunner and colleagues' work represents a unique application of the travelling-wave approach to NMR, there are strong analogies with methods used in electron spin resonance and optics. Transfer of ideas that have already been developed for these more mature areas of application should shape future exploitation of the travelling-wave approach in NMR and MRI, and ensure that its full benefits can be realized. ■

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