

Application No:	Consultees Name:	Received:	Comment:	Response:
2021/0598/P	Hamish Birchall	18/04/2021 11:38:08	OBJ	<p>Response submitted 18 April 2021 from Hamish Birchall to the Waldon Crest View phone mast proposal, Camden planning application reference ref. 2021/0598/P</p> <p>Index</p> <ol style="list-style-type: none"> 1. Objection on siting and appearance grounds 2. Waldon's siting rationale 3. Bats 4. The 5G rationale <p>1. Objection on siting and appearance grounds</p> <p>I object to the phone mast installation on the roof of my home, Crest View, on siting and appearance grounds. The masts proposed are almost a third of the roof height of the building and will have a very significant negative visual impact for miles around.</p> <p>Due to its position and height, Crest View is a prominent local landmark. It is visible for at least 10 miles east south and west, the flat roof being only about 30ft below the level of Parliament Hill.</p> <p>Crest View is adjacent to St Mary Brookfield, a Grade II star listed church, sited on the south side of Dartmouth Park Road. Note that the roof heights of the church and Crest View are almost the same. (Photos to be emailed separately).</p> <p>Crest View and St Mary's are in clear view looking east from many parts of Hampstead Heath, particularly from the ridge that runs from Kenwood to Parliament Hill. Film and tv broadcasts about the area often include shots of Crest View and St Mary's side by side. This happened recently, for example, in the BBC Countryfile special "Hidden Treasures" broadcast on Sunday 28 February this year, and repeated twice since. Crest View is in prominent view at 2'27" to 2'35" and reappears in long shots at 26'58" and 46'10".</p> <p>Moreover, the block is in the middle of two conservation areas, Dartmouth Park in Camden and St John's Grove in Islington. The Dartmouth Park Conservation Area Appraisal and Management Statement, adopted by Camden in 2009, states:</p> <p>"The prominent position of the [Crest View] flats and the bland design dominate the corner to its detriment." ["Sub area 3, Dartmouth East", 7.56, p22]. The Statement also cites Crest View expressly as a "negative feature". [ibid, p24]</p> <p>Any phone mast installation on Crest View's roof would inevitably make that negative impact worse.</p> <p>The Waldon phone mast installation proposal is therefore not merely insensitive and ill-conceived, it is also based on an incoherent siting rationale, as I hope to show in the section below.</p> <p>2. Waldon's siting rationale</p> <p>Waldon's case for choosing Crest View is inconsistent and misleading. Eight sites are listed that were</p>

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rejected for various reasons. But several other sites, all within 1km and meeting their site criteria are ignored.

Waldon's site plans for Crest View include antennae/apertures aligned south, south west and east. ["215 rev A - site plan" and "265 rev A – south elevation"]

All eight sites were within a few hundred metres of Crest View, but to the east or north east of the Islington side of Dartmouth Park Hill.

And yet six of the eight buildings listed as sites considered but rejected by Waldon could never have offered signal transmission or reception in those directions because they are at a much lower elevation and the signal would have been blocked to the east by the high ridge on which Crest View and the Dartmouth Park reservoir are sited.

Indeed, three of these six buildings are effectively one. Although presented within the document as separate, they are in fact within metres of one another on the same Islington council estate, all with more or less the same roof height: Merryweather House, Brennand Court and Aveling House.

In fact, only two of the eight Islington sites listed by Waldon could have provided the signal coverage they require: Hill House and the Dartmouth Park covered reservoir.

Waldon state that Hill House was their original installation site preference, but:

"... changes to the network in the area due to changes in neighbouring cells has led to a change in the search area for a replacement site. Hill House would no longer cover the search requirement and has therefore been discounted."

Hill House is not only significantly taller than Crest View, it is only 500m away. If Waldon's reasons for rejecting Hill House are genuine then that rationale should surely also have applied to all seven other sites.

Of the Thames Water covered reservoir, Waldon states that it was rejected because it "a greenfield site ... would have a greater visual impact than a rooftop site", and "there is a lack of space" [Supplementary Information, p8]. Both claims are nonsense.

The covered reservoir is a very large area, and the reservoir structure itself is surrounded by large grassed earth banks on which masts and supporting equipment could easily be sited.

Valmont, the company that makes the antennae/aperture supports proposed by Waldon for Crest View, is a US company with UK base in Stockton-on-Tees. It specialises in disguised antennae equipment, including masts disguised as trees or street lighting. Their website states:

"Often, the customers who demand reliable wireless service are the same ones who don't want a tower hovering over their home. We pioneered Minimum Visual Impact (MVI) or disguised towers with those customers in mind. They won't even notice a disguised tower. Instead, they'll see a flagpole, tree or clock tower never aware that there's a wireless tower underneath."

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See: https://www.valmontstructures.com/resources/photo_galleries#

Other nearby buildings that offer both the height and roof area Waldon say they require include:

1. Archway Tower, 2 Junction Rd, N19 5RQ
 2. Whittington Estate, Dartmouth Park Hill, N19
 3. Highgate Mental Health Centre, Dartmouth Park Hill, N19 5LX
 4. Whittington Hospital, Magdala Avenue, N19 5NF
 5. * Bacton Tower, NW5 4PU
 6. * Royal Free Hospital, Pond St, Hampstead NW3 2QG
- * already has some telecoms equipment

Waldon needs to explain why none of those buildings were apparently considered.

3. Bats

I am a lifelong amateur naturalist and bird watcher and have lived at Crest View for over 34 years.

Despite the fact that I was the Crest View resident who raised this with Waldon, and corresponded about it last year with Mr Chris Andrews of that company, neither he nor anyone else at Waldon bothered to tell me when Ms Fay Brotherhood of Arbtech would be conducting the bat survey. As a result, I was not present on Wednesday 20th January 2021 when it was carried out.

Ms Brotherhood was accompanied on the day by the Crest View managing agent, Paul Davison, but I do not believe he is knowledgeable about bats.

There are many problems with the Arbtech survey and I believe it needs to be done again:

- (a) The report dating is incorrect: it states that the first draft was prepared 21 February 2021, but the final, reviewed draft is dated 26 January 2020.
- (b) Under the Executive Summary its objectives include assessing "... the suitability of the site for barn owls". Any professional ecologist should know that the last record of a sighting of a barn owl near here was 1895 (Hampstead Heath).
- (c) Under 1.2 "Site context" it states that there are "two buildings and two trees within the site boundary". That is simply wrong. The Crest View property boundary extends significantly further than the plan provided in Appendix 1. There is a communal garden at the front of the building featuring 9 trees: 6 mature pollarded lime trees, one young but tall silver birch (20+ ft) and two mature hawthorns.
- (d) Both the communal garden and the 18 garages within the Crest View property boundary were missed on the site boundary as defined by Arbtech.
- (e) 8 of the garages are integral to the base of the apartment block on the south side, parallel with Dartmouth Park Road; 6 are within an outbuilding oriented north/south at the western property boundary; 4 project from the western side of the apartment block.

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(f) There is also an electricity sub-station projecting from the west side of the block, on the Dartmouth Park Road side.

(g) In addition there is a paladin waste area at the back, enclosed with wooden doors and louvred ventilation, a back entrance and three storage facilities with door entrances, all integral to the apartment block itself.

(h) These additional buildings/structures are relevant to any bat survey here in that there are many apertures of various kinds into which the pipistrelle bat (the smallest UK species) could readily enter, whether gaps between doors and walls, or louvred openings (such as the paladin waste area and the electricity sub-station).

(i) But none of the garages, nor the electricity sub-station, nor the paladin bin area, nor storage facilities were internally inspected by Arbtech.

(j) Another significant area that was missed was the block wall on the north side where it abuts our neighbour's property at 49 Dartmouth Park Hill. Bats flit over this part of our neighbour's roof on their summer evening foraging.

(k) Waldon suggests that data confidentiality prevented them from accessing local bat records. That is misleading in that those records for the two most important local bat sites, Hampstead Heath and Highgate Cemetery are publicly available. Highgate Cemetery confirmed to me that they had not been approached by Waldon; to the best of my knowledge, the City of London Corporation which is responsible for Hampstead Heath had also not been approached by Waldon.

(l) Last but not least, none of the flats' balconies were inspected. There are a number of small crevices on these. Adjacent to my own 2nd floor west-facing balcony there is very obvious recess in the brickwork that might offer temporary shelter to a bat.

4. 5G

Everyone's lives are about to get so much better and more exciting, according to Waldon's 2018 document "5G and Future Technology ..."

Your fridge will talk to your phone, your car will talk to the road, gamers will enjoy millisecond latency, films will download in seconds. Governments and the telecoms industry in Europe are doing a 5G roll-out conga right now, hence Waldon's Crest View application.

Except there's a fly in the ointment. Scientists around the world are lobbying the World Health Organisation to put the brakes on. Recent studies cast doubt on old assumptions about the safety of the electromagnetic fields (emf) emitted by mobile phones and the signal infrastructure they require, especially 5G infrastructure.

The European regulatory agency, ICNIRP, which sets emf safe exposure levels used in the UK, stands accused of ignoring the new research and having shady connections with the telecoms industry.

An excellent summary of these concerns was published this January by a UK epidemiologist, Professor John

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Frank: Electromagnetic fields, 5G and health: what about the precautionary principle?

An abstract is available here, but I will email the full paper separately as a supporting document:
<https://jech.bmj.com/content/early/2021/01/04/jech-2019-213595>

Although the planning committee's decisions on phone mast installations must be solely on siting and appearance, I urge the committee to read that paper. It is written in plain English and layman's terms.

Hamish Birchall

The attached photo is one of four to accompany the siting and appearance section of my objections to this planning application. The title is self-explanatory and the view is pretty much the same as the one of Crest View and St Mary Brookfield church featured in the opening of the BBC Countryfile special on Highgate Cemetery broadcast last February.

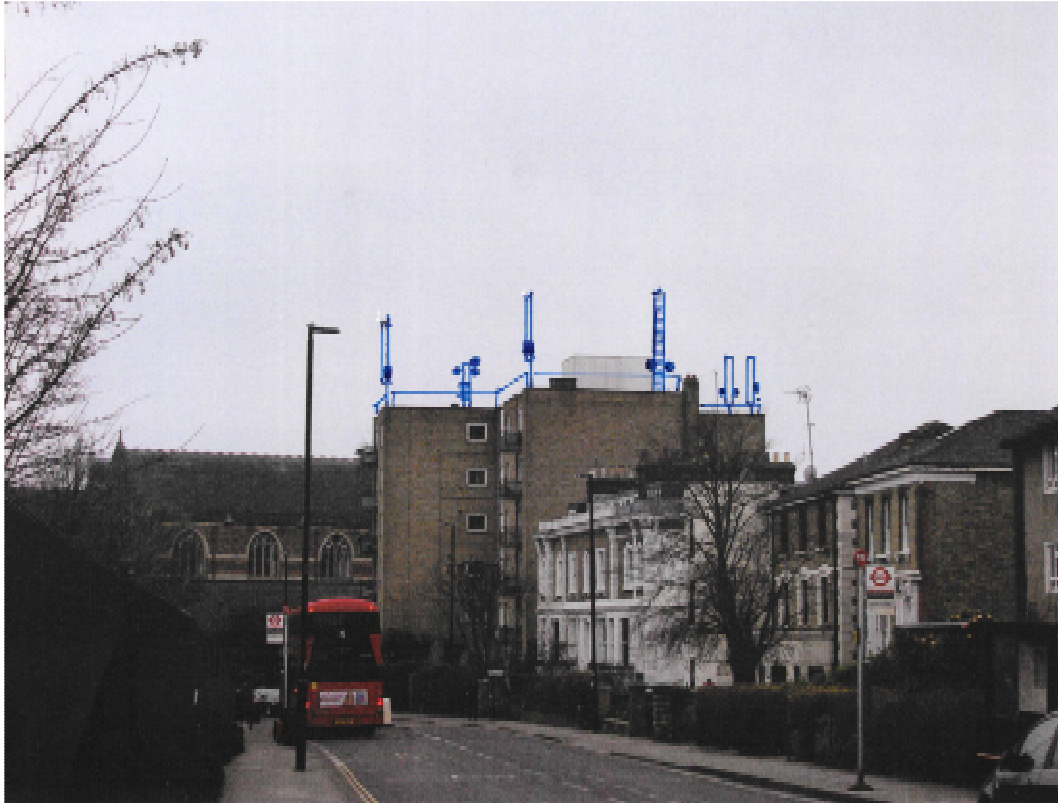
Note particularly that it confirms my statement that the roof heights of Crest View and St Mary's are about the same.



Crest_View_&_St_Mary_Brookefield_from_Holly_Lodge_estate

Here is the second of four photos to accompany the siting and appearance section of my objections to this planning application.

On this photo and the remaining two I have sketched in the masts approximately to scale. The filename gives the location from which the photo was taken (S = south, N = North etc).



Crest_View_with_masts_viewed_from_N_Dartmouth_Park_Rd

Here is the third of four photos to accompany the siting and appearance section of my objections to this planning application.

As with the previous photo I have sketched in the masts approximately to scale. The filename gives the location from which the photo was taken (S = south, N = North etc).



Crest_View_with_masts_viewed_from_S_Brecknock_Rd

Here is the fourth of four photos to accompany the siting and appearance section of my objections to this planning application.

Again on this photo I have sketched in the masts approximately to scale. The filename gives the location from which the photo was taken (S = south, N = North etc).



Crest_View_with_phone_masts_viewed_from_SW_Dartmouth_Park_Rd

This final photo is to accompany my objections under the "Bats" section of my submission.

It is adding a further point, and although I realise I am one day beyond the formal submissions deadline, I ask that you include it.

In the Arbtech Preliminary Bat survey submitted by Waldon Telecom it states of Crest View:

"To the north the gardens have more tree cover which is arranged linearly, creating routes to the large block of woodland on the northern horizon. Any bats emerging from the site would need to cover considerable open space before reaching the trees, rendering them vulnerable to predation."
[p14]

That is not the case. There is mature tree cover all the way from the west facing gardens of Dartmouth Park Hill to the woods of Highgate Cemetery where many bat species reside.



Trees_view_north_from_Crest_View_HBirchall_W_balcony

Electromagnetic fields, 5G and health: what about the precautionary principle?

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ABSTRACT

New fifth generation (5G) telecommunications systems, now being rolled out globally, have become the subject of a fierce controversy. Some health protection agencies and their scientific advisory committees have concluded that there is no conclusive scientific evidence of harm. Several recent reviews by independent scientists, however, suggest that there is significant uncertainty on this question, with rapidly emerging evidence of potentially harmful biological effects from radio frequency electromagnetic field (RF-EMF) exposures, at the levels 5G roll-out will entail. This essay identifies four relevant sources of scientific uncertainty and concern: (1) lack of clarity about precisely what technology is included in 5G; (2) a rapidly accumulating body of laboratory studies documenting disruptive in vitro and in vivo effects of RF-EMFs—but one with many gaps in it; (3) an almost total lack (as yet) of high-quality epidemiological studies of adverse human health effects from 5G EMF exposure specifically, but rapidly emerging epidemiological evidence of such effects from past generations of RF-EMF exposure; (4) persistent allegations that some national telecommunications regulatory authorities do not base their RF-EMF safety policies on the latest science, related to unmanaged conflicts of interest. The author, an experienced epidemiologist, concludes that one cannot dismiss the growing health concerns about RF-EMFs, especially in an era when higher population levels of exposure are occurring widely, due to the spatially dense transmitters which 5G systems require. Based on the precautionary principle, the author echoes the calls of others for a moratorium on the further roll-out of 5G systems globally, pending more conclusive research on their safety.

BACKGROUND

Fifth generation (5G) technology is being widely promoted by politicians, government officials, and private sector interests.^{1–3} They contend that its advent will bring clear economic and lifestyle benefits, through massive increases in wireless and mobile connectivity at home, work, school and in the community. Examples of these 5G benefits include driverless vehicles and ‘The Internet of Things’—automated and continuous communication between the machines in our daily lives.^{4,5} On the other hand, the public health response to this wave of communications innovation has become a sense of deep concern, related to widespread scientific uncertainties, as well as a lack of use of existing evidence, in the current international safety guidelines for 5G and related radio frequency

electromagnetic field (RF-EMF) exposures.^{5–8} This commentary sets out the reasons for such concern.

WHAT IS 5G AND WHY IS IT DIFFERENT FROM PAST EMF EXPOSURES?

Developed over just the last decade, radio frequency (wireless) transmission systems in the 5G category are being rolled out throughout the world. These systems will massively increase the volume, speed and spatial reach of digital data transfer.^{4–6} The four successive previous generations (1G, 2G, 3G and 4G) of wireless transmission systems were deployed initially for wireless and mobile phones (1980s and 1990s), followed by WiFi (2000s), and then smart metres and the Internet of Things (2010s). Each successive generation of transmission systems has used higher frequencies of electromagnetic waves to carry ever-larger volumes of data, faster, in more ubiquitous locations. 5G is widely acknowledged to be a step change in this sequence, since it additionally uses much higher frequency (3 to 300 GHz) radio waves than in the past. 5G will also make use of very new—and thus relatively unevaluated, in terms of safety—supportive technology (including pulsing, beaming, phased arrays and massive input/massive output (MIMO)—see below) to enable this higher data transmission capacity.^{4–6}

However—unlike prior generations of wireless transmission systems—5G ultrahigh-frequency waves are easily interrupted by vegetation foliage (and building walls, often requiring additional signal boosting within each building). This inherent fragility of 5G high-frequency waves means that transmission boosting ‘cell’ antennae are generally required every 100–300 m or less—far more spatially dense than the miles-apart transmission masts required for older 2G, 3G and 4G technology using lower frequency waves.^{4–6}

This dense transmission network is also required in order to achieve the ‘everywhere/anytime’ connectivity promised by 5G developers, and necessitated by new technology such as driverless cars, which must never be out of internet contact, for safety reasons. Critics of 5G agree^{6–8}—but its supporters do not^{9,10}—that the overall population levels of exposure to RF-EMFs will be greatly increased by the 5G roll-out. One compelling argument for that view is the ‘inverse square law’ of EMF exposure: intensity varies as the inverse of the square of the distance from the emitting source.¹¹ With plans afoot internationally to put a 5G booster antenna on ‘every second or third lamp-post’, it is difficult to believe that overall population exposures will not increase substantially. Existing 4G



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systems can service up to 4000 radio frequency using devices per square kilometre; 5G systems will connect up to one million devices per square kilometre—greatly increasing the speed of data transfer (by a factor of 10) and the volume of data transmitted (by a factor of 1000).⁶

THE CURRENT CONTROVERSY

International health protection agencies and their scientific advisory bodies have published several reviews over the last decade, of varying scientific quality, of the research evidence regarding potential adverse biological and health effects of RF-EMFs.^{5,12–15} These reviews—by Health Protection England,¹² the International Agency for Research on Cancer (IARC),¹³ an Expert European Union (EU) Committee¹⁴ and the International Commission on Non-Ionising Radiation Protection (ICNIRP)¹⁵—have, with one exception, not converged around a strong warning about such effects. IARC is the outlier in this respect, having determined in 2011 that EMFs are ‘possibly carcinogenic to humans’.¹³ Meanwhile, independent radiation and health scientists have published serious concerns about the current roll-out of 5G transmission systems.^{6–8, 16–18} Their reasoning is twofold: (1) these systems have an unprecedented potential to create human and non-human RF-EMF exposures orders of magnitude more intense (eg, in terms of ‘power flux density’) than was the case only a few decades ago (16); (2) there is a remarkable dearth of evidence on the safety of 5G-specific EMF emissions, but a growing body of research suggestive of harms from other RF-EMF exposures, which have been studied for much longer.^{6–8, 17, 18}

Moreover, a growing number of engineers, scientists, and doctors internationally have been calling on governments to raise their safety standards for RF-EMFs, commission more and better research, and hold off on further increases in public exposure, pending clearer evidence of safety.^{18–21} Some politicians have listened: France, Israel, Cyprus and Russia have banned WiFi in preschool and restricted its use in primary schools. Belgium has banned the sale of mobile phones to children under seven. In response to such concerns, several jurisdictions have recently blocked the installation of 5G antennae systems in their communities: Brussels, Florence, Rome, as well as Glastonbury, Frome and Totnes in the UK; and widespread anti-5G campaigns are now emerging in Australia, North America and elsewhere.²¹

Some countries have lowered allowable RF-EMF exposure levels far below those permitted in the UK and USA. Powerwatch, a non-profit, independent organisation in the UK, has published comparisons of international recommendations on permitted maximum exposure levels to EMFs.²² Those comparisons show that the highest permitted RF-EMF exposures which are used globally, as the basis for national safety guidelines, are those used in the USA, the UK and most of the EU. These exposure limits are derived from the recommendations to WHO in 1998 (recently updated, but essentially not changed, in March 2020) by the ICNIRP.¹⁵ These international comparisons show that the safety limit for RF-EMF exposure set by ICNIRP is 10-fold higher than that set by the next most liberal guidelines, found in Israel and India, and 100-or-more-fold higher than the limits set by other guidelines, spanning 14 EU jurisdictions as well as China. As discussed in detail below, one reason that ICNIRP’s permitted exposures are so high is that they are based solely on the acute thermogenic (heat-producing) effects of RF-EMF in animal tissues; this is unlike more conservative jurisdictions’ guidelines, which are based on a wider variety of biological and health effects documented in recent decades, including effects

resulting from chronic rather than acute exposures, and effects not mediated by thermogenesis.

KEY CONTENTIOUS ISSUES AND SCIENTIFIC UNCERTAINTIES

Lack of clarity about precisely what sorts of EMFs will result from 5G roll-out

A striking feature of this public controversy is that various commentators—even those with advanced training in telecommunications physics and engineering—inconsistently refer to quite different specific technologies when they discuss the pros and cons of ‘5G’. American authors tend to state that the 5G system roll outs already underway in that part of the world are using very high-frequency (24–100 GHz)/short-wavelength RF transmission—so-called ‘millimetre range’ waves.⁶ However, some UK/EU industry websites⁹ state that ‘no new frequencies are required’ (at present) beyond those already in use in existing 4G mobile networks, WiFi, smart metres. However, independent authors commenting on current private sector plans in the EU, to extend 5G networks more widely in the future, tell a different story.^{23, 24} These commentaries imply that the use of millimetre wave frequencies—about which we have very few conclusive studies of human health effects—is already planned and inevitable in the EU, and eventually globally, in order to accommodate anticipated consumer requirements—especially the ‘Internet of Things’ and driverless vehicles. Tellingly, the Guardian (one of the UK’s most respected newspapers) reported last year²⁵ that UK lamp posts were becoming the subject of expensive legal battles, over ‘who can charge what’ for mounting 5G booster cell antennae on them. Cash-strapped Local Councils had hoped to profit from such charges to telecom companies. These companies have taken local governments to court to block those charges. The USA provides a cautionary tale in this respect: nearly 25 years ago national legislation there took local authorities completely out of the telecommunications regulatory system, leaving local 5G installation and similar decisions entirely in the hands of central authorities—that is, the Federal Communications Commission.⁶

Equally inconsistently described in writings about 5G is the complex set of special signal modulations, pulses, polarisation, phased arrays and novel equipment designs—for example, ‘massive MIMO antennas’—which represent the cutting edge technologies that accompany 5G system installation—many of them proprietary. As some commentators on potential health effects from such exposures have pointed out, it is highly likely that each of these many forms of transmission causes somewhat different biological effects—making sound, comprehensive and up-to-date research on those effects virtually impossible.^{5–7, 26, 27}

In short, ‘5G systems’ is not a consistently defined term. This confusion has not helped clarify the health and safety issues surrounding 5G roll outs internationally.

An emerging preponderance of laboratory studies indicating RF-EMFs’ disruptive biological effects: with many knowledge gaps

The lack of a consistent definition of ‘5G’ matters enormously. This is clearly demonstrated in a sophisticated recent review of the laboratory science evidence of RF-EMF effects in diverse biological systems.²⁶ That review shows that the existing scientific literature on the biological effects of more recently developed technology is quite limited, in that there is hardly any study replication—the hallmark of reliable research. We often have only one extant study of any given biological effect of a specified combination of radio frequencies, modulation and

pulse patterns. The literature that does exist identifies remarkably heterogeneous biological effects, across hundreds of such specific RF-EMF exposure patterns. Furthermore, a comprehensive Canadian review of the same evidence states that some of the new RF-EMF technologies—such as innovations in radio frequency ‘pulsing,’ ‘polarisation’ and ‘modulation’—are so new that biological scientists have not been able to keep up—that is, no studies yet exist of these new technologies’ biological effects.²⁷

These recent reviews of laboratory (ie, non-epidemiological) studies of the biological effects of RF-EMFs do identify diverse, multibody system effects, operating by a range of physicochemical pathways which are not mediated by thermogenesis.^{6 8 26 27} The reviewers document a growing body of evidence that RF-EMF exposures produce effects spanning reproductive/teratogenic, oncological, neuropsychiatric, skin, eye and immunological body systems. In addition, there are many fundamental effects at the subcellular level, in terms of oxidation, DNA alteration, gene expression and bacterial antibiotic resistance. Particularly striking is a 2018 study from Israel documenting the capacity of the sweat ducts in human skin to act as ‘helical antennae’ receptive to 5G frequencies of RF-EMF. When sweat ducts are exposed to these RF-EMFs, there are remote systemic effects, through the skin’s established capacity to secrete and send hormones and other signals to the entire body.²⁸ This report alters one’s sense of the potential risks from such high frequency waves, since they have long been thought to be ‘inherently less dangerous’, because they are largely absorbed in the top few millimetres of exposed tissue (thus limiting any adverse effects, in theory, to the skin or eye).

Finally, it is instructive to look at the two widely cited NIH toxicological studies of specific EMFs’ effects on thousands of rodents,^{29 30} conducted by experienced and highly respected laboratory scientists at a world-leading institution. Since their publication in 2018, epidemiologists and other scientists have pointed out several methodological weaknesses in the conduct and analysis of these studies that make their unequivocal interpretation almost impossible, particularly in terms of their relevance to human health: excessive statistical inference testing of multiple (over 1000) hypotheses, without appropriate adjustment of p values considered ‘statistically significant’; reporting of results ‘often ignoring statistical tests’; failure to explain major internal inconsistencies of findings across EMF doses, tumour types and rodent sexes; use of experimental EMF exposures far in excess of any known human ones; uncontrolled confounding by direct thermogenesis effects—the list goes on.^{31 32}

In short, laboratory studies of EMF exposure are fraught with both internal and external validity issues, and cannot replace high-quality human epidemiological studies—though, as we will now discuss, these are also hard to come by.

Lack of conclusive human epidemiological studies of 5G-specific health effects (but increasing epidemiological evidence of serious health effects from previous generations of RF-EMF exposures)

Canada’s most senior cancer epidemiologist, Miller *et al* have last year summarised the human epidemiological evidence³³ linking human breast and brain tumours, male reproductive outcomes and child neurodevelopmental conditions to RF-EMF exposures resulting from the use of past generations of transmission systems. Critically, this evidence is not about exposure to the high radio frequency/short wavelength 5G systems. These systems are too newly deployed to have been extensively studied, especially by

the highest-quality epidemiological study designs for establishing evidence of causation: prospective cohort studies. Such studies typically require decades of follow-up to detect delayed health effects, such as most cancers.

Miller *et al* find compelling evidence of carcinogenesis, especially in the brain and acoustic nerve, as well as the breast, from strong RF-EMF exposures to previous generations of mobile phone transmissions. Perhaps the most convincing evidence they cite comes from the oldest and most-often-maligned study design—case reports. While admittedly old-fashioned, case reports can, when they involve pathognomonic effects (ie, pathological features absolutely specific to a particular exposure) provide useful evidence of exposure/outcome specificity—a valuable but often unobtainable epidemiological criterion for inferring causation, according to the standard epidemiological criteria first enunciated by Sir Austin Bradford Hill over 50 years ago.^{34 35} Strikingly localised breast tumours, of unusual morphology, have been diagnosed in several women with particularly strong exposures to previous generations of mobile phones: they habitually placed their phones in their bras, on the same side of the body where the tumour has developed. Miller *et al* call for an urgent update of the last (2011) review of EMFs and cancer by the International Agency for Research on Cancer.¹³ They predict that such an update would now rate RF-EMFs as, at minimum, ‘probable’ (not merely ‘possible’ as in 2011) carcinogens, based on current evidence.

Persistent allegations of unscientific bases for existing health protection guidelines on RF-EMFs and unmanaged conflicts of interest on expert advisory panels

A senior epidemiologist from Sweden, Hardell, has repeatedly published in peer-reviewed journals detailed allegations regarding the main WHO scientific advisory body on EMF health effects and safety—the previously mentioned ICNIRP. Hardell contends that ICNIRP’s membership includes over-representation of vested interests, especially the giant multinational telecommunications firms who are heavily invested in the roll out of 5G systems internationally.^{36 37} ICNIRP has long been influential in EMF regulation: its scientific recommendations to WHO were first issued in 1998, updated in 2009, and revised and updated again in March 2020.¹⁵ Hardell points out that ICNIRP’s pro-industry bias may explain its continued reliance only on studies of the thermogenic (heat-producing) effect of RF-EMFs in biological tissues: these studies would be expected to paint an overly benign picture of RF-EMF safety. This narrow ICNIRP focus flies in the face of published reviews by independent scientists (6, 8, 13, 26, 27) citing compelling research evidence, accumulating steadily over the last few decades, of non-thermogenic adverse effects of RF-EMFs, affecting diverse human and animal subcellular function, tissues and organ systems (see above). In detailed, almost lawyer-like publications,^{36 37} Hardell fastidiously documents the ICNIRP’s 20 years of dogged defiance, in the face of widespread criticism by other scientists, that the scientific base for their recommendations remains dated and narrow, rendering their guidelines on ‘safe’ RF-EMF exposure unsafe.

The most damning evidence adduced by Hardell is a table of the cross-appointments held by six members of the WHO Monograph Group, across five major international advisory panels on the health effects of non-ionising radiation [36 – page 408]. Hardell also describes these scientists’ strong personal links to the telecommunications industry, a situation likely arising from the fact that the ICNIRP itself is a ‘private organisation (non-governmental organisation; NGO) based in Germany. New

expert members can only be elected by members of ICNIRP. Hardell contrasts the ICNIRP's reports to the publications of the 'BioInitiative 2012'³⁸ group, of nearly 30 international experts in this field, whose operations are not only wholly independent of any such 'vested interests,' but also entirely transparent. The current version (March 2020) of the BioInitiative 2012 website³⁸ provides detailed descriptions of 988 peer-reviewed scientific studies of adverse potential health and biological effects of EMFs arising from RF and similar non-ionising sources. The vast majority (84.6%) of these 988 studies document disruptive biological effects from such EMFs, almost all of them operating via non-thermogenic pathways. (This writer would have preferred to see more 'critical appraisal' of the quality of the studies than the BioInitiative 2012 website provides. However, the major effort entailed in assembling this massive body of scientific evidence, and updating it regularly since 2012, is impressive).

Finally, Carpenter has recently published a well-researched analysis of how source of funding correlates with study findings, across many peer-reviewed publications over the last few decades, of the relationship between various kinds of EMF exposure and several cancers.³⁹ He shows convincingly that studies funded by private sector entities, with strong vested interests in maintaining their current use of the sources of EMFs under study, tend to find no association—whereas studies funded by public sector or independent sources find the opposite. As Carpenter points out, this suggests that many systematic reviews and meta-analyses in this field, having failed to correct for this 'source of funding bias,' likely underestimated the evidence for causation.

CONCLUSIONS AND RECOMMENDATION

In assessing causal evidence in environmental epidemiology, Bradford Hill himself pointed out that 'the whole picture matters,' he argued against prioritising any subset of his famous nine criteria for causation. One's overall assessment of the likelihood that an exposure causes a health condition should take into account a wide variety of evidence, including 'biological plausibility'.^{34 35} After reviewing the evidence cited above, the writer, an experienced physician-epidemiologist, is convinced that RF-EMFs may well have serious human health effects. While there is also increasing scientific evidence for RF-EMF effects of ecological concern in other species,^{6–8 16–18 23} both plant and animal, these have not been reviewed here, for reasons of space and the author's disciplinary limitations. In addition, there is convincing evidence, cited above, that several nations' regulatory apparatus, for telecommunications innovations such as the 5G roll-out, is not fit for purpose. Indeed, significant elements in that apparatus appear to have been captured by vested interests. Every society's public health—and especially the health of those most likely to be susceptible to the hazard in question (in the case of EMFs, children and pregnant women)—needs to be protected by evidence-based regulations, free from significant bias.

Finally, this commentary would be remiss if it did not mention a widely circulating conspiracy theory, suggesting that 5G and related EMF exposures somehow contributed to the creation or spread of the current COVID-19 pandemic. There are knowledgeable commentators' reports on the web debunking this theory, and no respectable scientist or publication has backed it.^{40 41} Indeed, combatting it is widely viewed by the scientific community as critical to dealing with the pandemic, as conspiracy theorists holding this view have already carried out violent attacks on mobile phone transmission facilities and other symbolic targets, distracting the public and authorities at a time

when pandemic control actions are paramount.⁴² This writer completely supports that view of the broader scientific community: the theory that 5G and related EMFs have contributed to the pandemic is baseless.

It follows that, for the current 5G roll-out, there is a sound basis for invoking 'the precautionary principle'.⁴³ This is the environmental and occupation health principle by which significant doubt about the safety of a new and potentially widespread human exposure should be a reason to call a moratorium on that exposure, pending adequate scientific investigation of its suspected adverse health effects. In short, one should 'err on the side of caution'. In the case of 5G transmission systems, there is no compelling public health or safety rationale for their rapid deployment. The main gains being promised are either economic (for some parties only, not necessarily with widely distributed financial benefits across the population) or related to increased consumer convenience. Until we know more about what we are getting into, from a health and ecological point of view, those putative gains need to wait.

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