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EDITOR'S COMMENTARY

Not many shoulders of giants to stand on these days

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If I have seen further (than others), it is by standing on the shoulders of giants.

Legend tells us that these words of Sir Isaac Newton were intended to convey a sense for how the accumulation of new knowledge builds upon our predecessors' accomplishments. And with each passing year, the scholars who have led the way for the emergence of human ARTs as we know it today encourage us to make progress in line with their foundational contributions to reproductive biology and medicine. The names of Edwards and Steptoe, the Joneses, Hartmann, Hertig, Rock, McLaren, and so many others come to mind as members of this ART hall of fame. And their legacies have withstood the test of time. So where we might ask will the next class of "giants" come from?

The core principles of discovery deployed by the previous generations' primal observers made their contributions with relatively simple methodologies and more than a modicum of trial and error, and of course some luck! Transitioning to today's world of ARTs, we experience something very different. Over the last three decades, technologies have become a driving force in daily practice, often extending well beyond the realm of reproductive physiology that for our forebears defined the substantive principles that guided clinical and laboratory practices to where they are today.

Possibly no better example of the link between the past and present comes from the career-long accomplishments of John Dennis Biggers, who we sadly share with our readership recently passed away. Followers of JARG likely recall the special issue we dedicated to him on the occasion of his 90th birthday some years ago [1]. And with his passing, we celebrate a life that for years will offer vision into the future of human ARTs.

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To the reproductive medicine community, Professor Biggers launched the revolution in embryo culture media development by melding principles of cell physiology with what was then an evolving landscape of the reproductive tract environments through which the embryo must pass on the road to implantation [2]. Hard to believe that already 16 years have passed since the first insights into the concept of two-step protocols embraced the "back to Mother Nature" approach as ART embryo culture strategies sought to lengthen the time of culture prior to embryo transfer [3]. And along this basic research pathway, Professor Biggers and his associates kept us in line with respect to the importance of transparency in media development and the ethical principles that should inform clinical practice [4].

What defines solid science that translates safely and efficiently into the ART laboratory is something we can thank Professor Biggers for as we approach what others have noted will be a period of directed science that is long overdue, despite the seemingly reckless trend to extend embryo culture for purposes that may in the end be contraindicated with respect to what is best for the conceptus [5]. Moreover, the nature of clinical research, its reliance on statistics, and the unavoidable complexities of human genetics have been artificially assembled to foster a mindset driving human ARTs today that regrettably may have consequences we failed to anticipate [6]. Among these looms the subject of epigenetics and intergenerational inheritance, matters still awaiting evaluation at a rigorous scientific level despite what work on animal models has revealed.

Animal research has provided the foundation for many of ART procedures employed today including embryo transfer, cryopreservation, and the ever-growing field of fertility preservation, once again highlighted in this issue of JARG. Also in this issue, Comizzoli, Paulson, and McGinnis provide a unique perspective of the nexus between animal research and ART development that we encourage our readership to take special notice of (*The mutual benefits of research in wild animal species and*

human-assisted reproduction, https://doi.org/10.1007/s10815-018-1136).

As a case in point, it is worthwhile to note that the vast majority of research on the relationship between maternal aging and aneuploidy has focused on mouse models whose chromosomal aberrations pale even under the most insulting of conditions when compared to the realities seen with human oocytes. Even worse is the failure to recognize that unlike humans who miscarry a high percentage of chromosomally abnormal embryos, mice resorb pregnancies (rather than expel or miscarry) independent of their ploidy status [7]. This word of caution can and should extend to the curious that interpretation of mouse studies claiming similarity to human disease conditions should be scrutinized before proffering remedies, treatments, or new procedures for which unchecked translation may hold surprises [8].

We hope you enjoy this issue of JARG and welcome feedback from our readership.

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