2019年
總統科學獎
PRESIDENTIAL SCIENCE PRIZE
表揚實錄
Award Ceremony Program

Mathematics and Physical Sciences
Life Sciences
Social Sciences
Applied Sciences

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序言

總統科學獎設立於 2001 年，今年已經邁入第 10 屆；象徵國內學術研究最高榮譽的總統科學獎，由中央研究院院長邀集相關部會首長，以及專家學者共 15 人組成「總統科學獎委員會」籌劃總統科學獎項，並於 2001 年起，每 2 年頒發一次，以獎勵國內在數理科學、生命科學、社會科學與應用科學領域，有重大貢獻的基礎學術研究者，並提升臺灣之國際學術聲譽。

總統科學獎得獎人的產生，係由中央研究院院士或總統科學獎得主，或總統科學獎委員會得邀請學術、研發單位或團體及社會賢達人士提名，分由 4 組遴選小組推薦候選人，再經聯席會議審議遴選得獎人。本屆總統科學獎歷經縝密的推薦及遴選程序，計遴選出 3 位得獎人，分別為數理科學組李遠鵬院士、生命科學組陳垣崇院士及應用科學組魏福全院士（依姓名筆劃順序）。

由總統科學獎的頒發，表達國人對科學前景崇高的冀望、對人才培育的重視與對知識份子的無限尊崇，除了彰顯得獎人的崇高學術地位之外，更期盼將科學的精髓發揚光大，裨益民生。

數理科學組
李遠鵬 院士

生命科學組
陳垣崇 院士

應用科學組
魏福全 院士

成就事蹟 數理科學組— 李遠鵬 院士

探究自然本質　樂此不疲

在臺灣孕育出世界級的研究

李遠鵬教授於 1952 年出生於新竹。臺大化學系畢業服兩年兵役後，赴柏克萊大學攻讀博士，師從享有崇高學術地位的 George Pimentel 教授，開啟了李教授長年致力於自由基領域的研究歷程。

完成博士學位以及兩年的博士後研究後，於 1981 年回臺擔任國立清華大學 (簡稱清大) 化學系副教授。當時，臺灣進行現代基礎物理化學實驗的人很少，環境艱困，但李教授一路走來扮演了關鍵的角色，默默地為臺灣現代化的基礎科學教育和研究奠定了堅實的基礎，產生了深遠的影響。

李教授在科學教育方面的貢獻包括，在清大建立了現代化的物理化學課程，並首次引進化學動態學、雷射化學、物理化學研究技術、雷射化學實驗等課程，同時也是第一位將高解析霍氏紅外光譜儀 (FTIR) 引進臺灣的人。此外，李教授指導了臺灣為數眾多的物理化學家，這些人才畢業後開枝散葉，各有成就，成為產業與學界的中堅份子。

李教授在行政工作上也有優異的表現與貢獻。1991-2003 年在清大擔任國科會貴重儀器中心主任期間，將中心儀器從 12 臺擴展到 28 臺，增添許多在化學、生物和材料分析領域的最先進儀器，也因此服務了全國極多科學家，使其可以使用最好的儀器從事研究，在提升臺灣研究水平中發揮了關鍵作用。

2004 年轉任國立交通大學 (簡稱交大) 後，於 2005-2008 年擔任理學院院長，大力提升理學院的研究質量和國際化，包括爭取經費規劃建設「基礎科學教學研究大樓」、協助設立開放式網路教學 (OCW) 、設立「跨領域科學學士班」，招收優秀的大學生進行跨領域科學的培養，並選送國外交換研究。

此外，李教授亦於 2006-2017 年教育部邁向頂尖大學計畫中擔任「前瞻跨領域基礎科學中心」主任，組織數個跨領域研究團隊，致力於對國家經濟極為重要的再生能源、生醫檢測和尖端物質及元件之研究，成果卓著。

為了促進交大理學院的國際化，李教授除了延攬多位外籍教授，還大力推動國際交流及合作。這些教授不僅給臺灣帶來了獨步世界的技術和研究題材，還協助臺灣和日本及其他國家科學家及研究機構建立廣泛和深入的交流和合作，確實地提升了臺灣的國際學術地位和國際化。

在學術研究方面，李教授自回臺後，在自由基光譜學、動力學和動態學領域做出了重要的貢獻。多年來，李教授已經發現一百多種在大氣化學、燃燒化學或天文化學上重要新的自由基或其新的光譜，得到了國際上的高度認可。

李教授是世界上仲氫 (*para*-hydrogen) 間質隔離技術和步進式掃描時間解析霍式紅外氣態吸收光譜技術的領導者，並獲選為美國物理學會會士 (1999)、中央研究院院士 (2008)、第三世界科學院 (TWAS) 院士 (2011)。近年來亦獲得許多國際獎項，包括 2016 年獲日本光化學會本多 - 藤嶋獎、2017 年獲德國宏博研究獎。2018 年獲 George Pimentel 獎，是間質隔離研究最高榮譽。

李教授是世界上第一個發展以步進式掃描時間解析霍式紅外光譜研究不穩定氣體自由基紅外吸收光譜的先驅者，並利用此技術首次檢測到許多自由基的紅外光譜。其中一項重要貢獻是，李教授率先測得庫利基 (Criegee) 中間體的紅外光譜，並發現其快速之自身反應，帶動了世界上此領域之研究。庫利基中間體是六十多年前被提出的極重要的大氣化學反應中間體，和大氣中臭氧消失、羥基 (氫氧根) 產生及氣凝膠產生關係密切，李教授的此一發現，為相關研究建立了重要里程碑。

在量子固體仲氫間質隔離方面，透過使用仲氫量子固體做為新的間質，發展了許多全新的應用，更使李教授成為此領域的領導者。此外，最近又新創利用電子槍產生帶質子的多苯環化合物，檢視其紅外光譜來推測外太空一些未知紅外譜帶的來源，又發展高效率氫原子反應法研究外太空重要分子之氫化反應，解釋了一些多年來的天文觀測謎團，對星際化學有重大貢獻。這些都是李教授多年來不懈投入的成果，李教授的努力，不僅為臺灣的科研教育做出卓越貢獻，更證明了，臺灣也有能力做出世界一流的研究成果，值得引以為傲。

矢志投入基礎研究
自由基光譜技術領先全球

求真求實 為國內科教貢獻心力

李遠鵬教授 — 一個從小就數理表現優秀，喜歡動腦和親手修東西的小男生，在經過嚴謹的教育訓練以及數十年來勤奮不懈地投入研究後，成就了他在自由基光譜學領域的國際領導地位。難得的是，李遠鵬近四十年來的研究工作都是在國內完成的，如他所說，「儘管臺灣沒有船堅炮利的最尖端昂貴儀器，但還是有機會做出世界級的研究，證明臺灣也是有實力的。」

另一方面，長年任教於清大與交大的他，亦為國內現代化的基礎科學教育和研究奠定了堅實的基礎。除了為臺灣培育為數眾多的物理化學家之外，也曾擔任行政工作展現長才，為提升交大理學院的研究質量與國際學術地位貢獻卓越。儘管多次獲獎，倍受尊崇，但低調的李遠鵬認為自己只是樂在工作，因緣際會下努力被肯定而已，充分展現出謙謙君子的平實風範。

大家庭中成長　受姊姊影響深

李遠鵬於 1952 年出生於新竹，家中有八個兄弟姊妹，排行老么。儘管現在看來，父親是知名水彩畫家李澤藩，大哥李遠川和二哥李遠哲都是名聞國際的科學家，甚至創下與兩位哥哥並列中研院院士，「一門三傑」的光榮紀錄，但對當時還是小男孩的他來說，童年生活卻是再簡單平凡不過的。

「大哥大我 20 歲，二哥大我 16 歲，他們分別在我小一和小六時出國留學，而且之前也都在臺大唸書，不常在家，我對他們的印象並不多，」李遠鵬回憶道。「與我感情最好，影響我最深的其實是大我三歲的三姊季眉。」李季眉臺大農化系畢業，留學德國，曾任中興大學環工系教授及副校長，現已退休。

「我出生時父親已經 45 歲，大哥常說，我們回憶中的父親好像不是同一個人，」他笑說。「哥哥們出生時還在日據時代，父親管教很嚴。大哥還曾經被關在大浴桶裡罰禁閉，暗無天日。而我和三姊就都沒被打過，雖然媽媽說，那是因為我們很乖，不需要打，但我想可能因為是時代改變以及父母年紀較長吧！」

在李遠鵬的印象中，父母並沒有特別要求他的學業，也沒有希望他一定要朝哪個方向發展，甚至大學聯考的志願也是自己填的，完全沒有干涉。但因為他當時僅填了 20 個志願，媽媽只能擔心地問說，「填這樣夠嗎？」

倒是三姊季眉在李遠鵬的求學過程中，扮演了提攜的重要角色。「記得我念初中時，開學後才知道英文老師沒來報到，隔了好幾個禮拜才由校長來暫代，所以一開始時我的英文學得不是很好。三姊知道後很著急，督促我加油，也幫我跟上進度。若是沒有她的幫忙，英文不好應會對我未來的研究與學習帶來很大的影響。」

不只如此，李遠鵬口中才藝兼備的三姊，在念高中時，還會把課本先給他看，與他分享心得，激發他對讀書的興趣，也因此養成習慣，不用等學校開學發課本下來，很多書都已經先讀過了！

「很多事都是三姊一路照顧我的，像我以前吹長笛也是因為三姊先學豎笛，鼓勵我一起學習的關係。」李遠鵬感激地說。在高中時期，他還曾與家族的堂表兄姊們一起開音樂會表演，其樂融融。

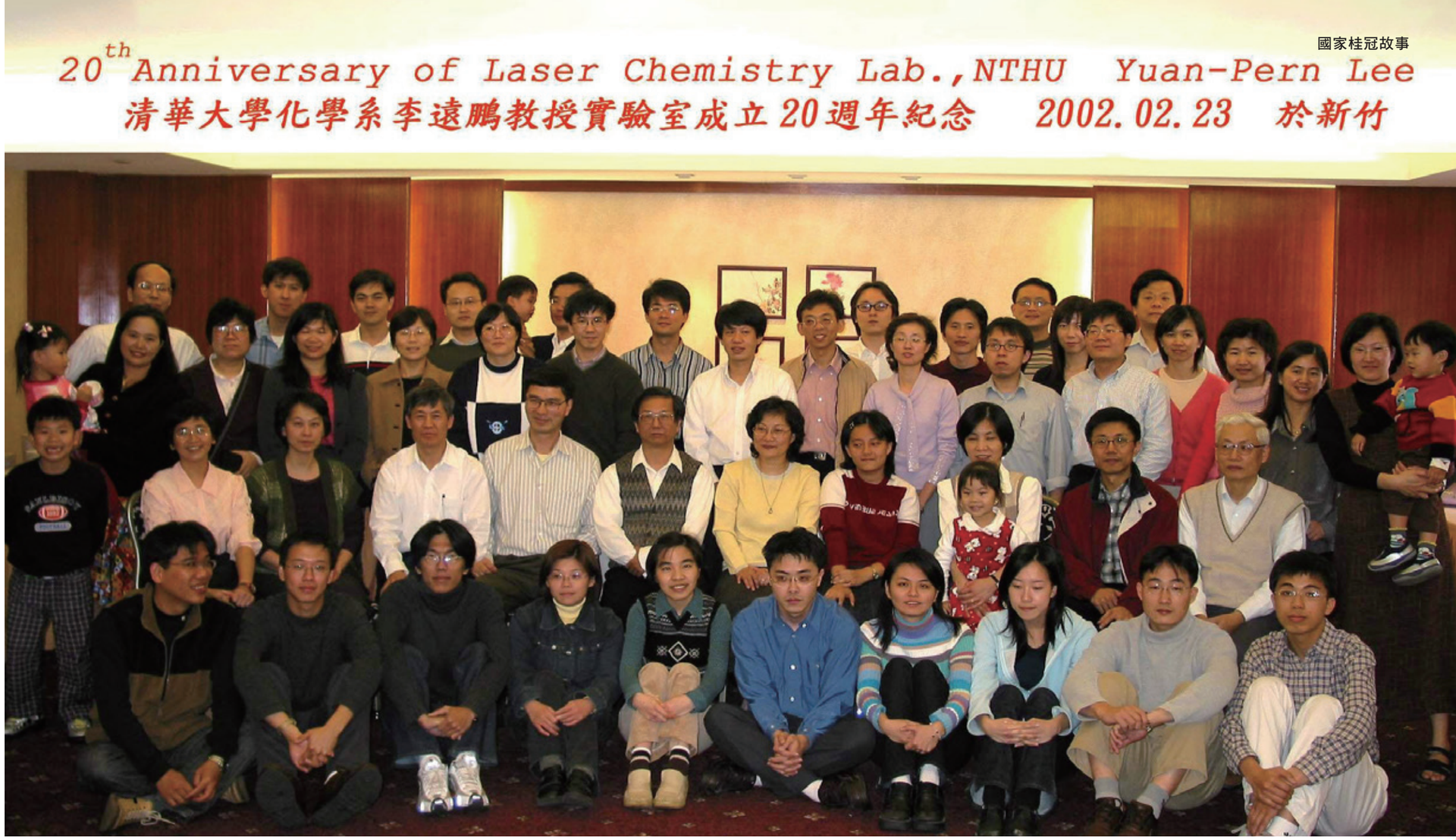
求學順遂　從小名列前茅

說起求學過程，李遠鵬說自己小時候也曾經調皮貪玩，不交作業。不過小六起比較懂事，成績就名列前茅，大學聯考的成績，想進任何科系都沒問題，但李遠鵬決定以臺大化學系為其第一志願。

「在當時，一般認為要走科學才有前途。雖然物理、化學、數學三個學科中，我的數學最好，但當時的觀念覺得念數學會沒飯吃，而我雖然喜歡物理，但表現相較之下又沒那麼傑出。在刪去法選擇之下，就決定朝化學發展。」

「我知道自己是喜歡唸書和工作的人，走研究路線是自然而然的。記得我小時候就喜歡修東西，像鬧鐘壞了，就會拆開來修理，雖然不懂，但總想嘗試看看，往往會瞎貓碰到死老鼠，就被我修好了。所以，有時姑母東西壞了還會找我去修理呢！」

雖然優秀的哥哥姊姊們也都是唸化學，「我想這方面他們對我倒是沒有重大影響，這是我自己的選擇，不過他們都朝這方面發展，讓我覺得這應該也是不錯的領域吧！」他笑說。資質聰穎的他坦言，讀書信手捻來，要努力但並不費力。唸臺大時，還曾參加交響樂團，吹奏長笛，擔任過團長，但同樣也是名列前茅地畢業。



負笈柏克萊　重新學習更努力

臺大畢業後，李遠鵬隨即前往柏克萊攻讀博士學位，展開了全新的學習體驗。「雖然我書讀了不少，但從實驗角度看，其實是一無所知的去，完全沒有經驗。不僅連最簡單的真空系統都沒有看過，不會吹玻璃製作實驗器材，甚至連最基本的實驗記錄簿都不會寫。」

「進了實驗室才知道原來自己差別人這麼多，心裡唯一的想法就是要盡快趕上，」他說。「這對我來說是一個衝擊，我努力的程度比在臺大時高了不知多少倍，因為有好多東西要學，除了吃飯睡覺，時間幾乎全都耗在實驗室。」用功的程度甚至連朋友的周末邀約也拒絕，完全埋頭工作，最後朋友不禁問道，「Who is checking on you?」

在李遠鵬的自我要求與努力下，很快地就趕上進度，甚至指導教授還想讓他第三年結束就可畢業。「我教授在我第四年時要去華盛頓特區的國家科學委員會任職，一年不在，因為我的研究也做得差不多了，就告訴我說如果我想要，就讓我畢業。」

「那時柏克萊化學系博士的平均取得時間是 4.9 年，我若能三年畢業，將來跟孩子誇耀很神氣，當下確實很猶豫。但想到，正是實驗做得順手的時候，還有很多研究想做，無須貪快，所以就決定再留一年。」

事後證明，這個決定是對的。這一年，因為老師不在，學生的好壞程度便能進一步凸顯。用功的李遠鵬，因為獨立性高，反而做出不少成果，並與老師定期討論，讓老師更知道他的能力，甚至還建議他無需再花時間做博後研究，可直接去當教授。

不過，好學如他，仍認為要到不同的次領域繼續學習，擴大視野，後來進入美國國家海洋暨大氣總署環境研究所，擔任研究員，進行兩年的博士後研究，學習了大氣化學和反應動力學。

師從名門　領受大師風範

李遠鵬的指導教授 George Pimentel 是化學雷射的發明人，也是以間質隔離技術進行自由基研究的先驅，享有崇高的學術地位。投入門下，開啟了李遠鵬長年致力於自由基領域的研究歷程。

回憶與老師的相處，除了授業解惑之外，李遠鵬表示，「老師對我更大的影響是在於精神層面，尤其是他為人處世的態度以及看待學生的方式。」

「老師對學生完全不吝於鼓勵。我剛進實驗室時，什麼都不懂，其他同學難免抱怨，有些話也必定傳到老師耳裡。但某次小組會議，在我第一次進行報告後，老師當面稱讚我講得不錯，能預期別人可能問到的問題，預做準備。我想除了給我信心之外，也是順便說給其他同學聽的！而且即使是面對不認真的學生，老師也是用引導、激發學生興趣的方式來帶領。」

「此外，在我們那個年代，是以實驗研究為主流，理論計算才剛起步，許多老師都對計算嗤之以鼻，認為不可能比實驗準確。但我卻想試試看，能否從不同的角度來印證我的實驗結果。老師雖然心裡可能覺得不以為然，但仍同意我跟隨另外一位教授學習電腦計算。」

後來，李遠鵬度過了一段實驗、計算兩頭燒的日子。白天忙實驗，晚上去電算中心跑計算，整天都在工作。好在辛苦是有代價的，計算取得了滿意的成果，也讓老師對理論計算的看法改觀。「一位大牌教授能有這樣的胸襟與雅量，真是很難得的，這也影響了我日後的教學與研究。」他說。

決定回臺　為科教研究扎根

完成博士後研究，儘管若想繼續留在美國教書研究，對表現優異的李遠鵬來說輕而易舉，但他卻連應徵都不去，就決定回臺任教。

「我回臺主要有幾個考量。首先，父母已經年邁，父親還曾中風，但多數孩子卻都不在身邊，讓我覺得應該回家幫助他們。此外，當時國科會給新進教授的研究經費已經較以往多，較有可能讓我可以繼續在學校做研究，否則只是教書，難免覺得委屈。而且，當我唸大學時便覺得臺灣的師資不夠好，我們在學成後便應該回國改變環境，不只是批評而已。更重要的是，我太太也支持我的想法，讓我能夠沒有阻力地下定決心。」

於是 1981 年，李遠鵬回臺擔任清大化學系副教授，才 29 歲。然而年少氣盛的他，回來後卻因為想申請足夠的國科會經費購買實驗設備受阻，而倍感挫折。「回顧多年的研究歷程，這大概是最挫折的時期了。我滿懷著熱忱，卻沒有獲得支持，差一點就想回美國去。」

幸好，在時任化學系主任張昭鼎和劉兆玄教授的協助下，讓李遠鵬有機會獲得系內經費支援並參與其他的計畫，研究工作才能慢慢步上軌道。「我回來後的第一篇論文是隔了四年，到 1985 年才發表的，確實耽擱了不少時間。」

排除了起步難的困境後，李遠鵬便順利地在清大展開教學與研究的工作。這期間他曾兩度獲頒清華傑出優良教師，展現其教學的熱忱與專業，也曾於 1991-2003 年間擔任貴重儀器中心主任。透過積極爭取經費和優秀管理，清大貴儀中心在服務和設備方面是全國最好的，也因此協助了國內許多科學家的研究工作。

轉任交大　行政工作建樹豐

2004 年，李遠鵬在交大分子科學研究中心主任林明璋院士和校長張俊彥的邀請下，決定轉往交大任教，並於 2005 年接下理學院院長職務。「在清大化學系時，我曾數度有機會擔任系主任，但我因為想專注研究，喜歡做有意義的事，不喜行政工作，所以都回絕了。但這次，我不但轉任到一個當時相較之下環境沒比較好的系，還又當上院長，讓不少清華同仁跌破眼鏡呢！」他表示。

當年交大申請到頂尖大學 5 年 500 億的經費，同仁們認為需要李遠鵬來領導提升交大理學院的研究能力，雖然這不在其原先的規劃，李遠鵬體認到這個契機，便決定承擔責任，投入這份「有意義」的行政工作。儘管只做一任，但在三年的理學院院長任期間，他積極地的推動各項計畫，被讚譽為相當於完成了十年的重要工作。

細數他的建樹，包括設立「前瞻跨領域基礎科學中心」提升研究能力、建立正常化的組織運作、爭取經費規劃建設「基礎科學教學研究大樓」，並設立「跨領域科學學士班」，招收優秀學生進行跨領域科學的培養、推動 OCW 網路教學等等。此外，他還大力促進交大理學院的國際化，延攬多位頂尖外籍教授，並積極推動國際交流與合作，提升了臺灣的國際學術地位和國際化。

這些舉措為交大理學院奠定了扎實根基，開始急起直追，特別是，交大應化系發表論文的總數與質量突飛猛進，幾年後的表現已不比清大和臺大遜色。「現在回頭看，我覺得當初做了正確的決定，在交大開放和靈活的校風下，以及歷任校長的信任和支持，讓我有機會能做出一點貢獻。」

儘管績效卓越，李遠鵬一任期滿，便功成身退，又回去專注於他最熱愛的研究工作，僅擔任研究中心計畫主持人。「其實我不是一個有雄心壯志的人，一定要達成什麼目標。只是順應情勢，該承擔時就承擔，要做就把事情做好，如此而已，」他謙虛地說。

「我想我是少數面對機會會說「不」的人，因為我會評估自己的時間分配，絕不會過度承諾，接了太多職務讓自己忙不過來，而只要我答應的事，就會認真做到。」

形容自己「腦子可以像開關一樣，能夠高效率地在不同工作間切換，完善規劃時間，準確掌握時程。」也因此，儘管行政工作忙碌，李遠鵬在擔任院長時，發表的論文數也絲毫沒有減少，一切都按部就班地照計畫進行。「我可以自豪地說，我從來不曾忙到焦頭爛額，超過期限才把工作交差！」

努力不懈　自由基研究傲全球

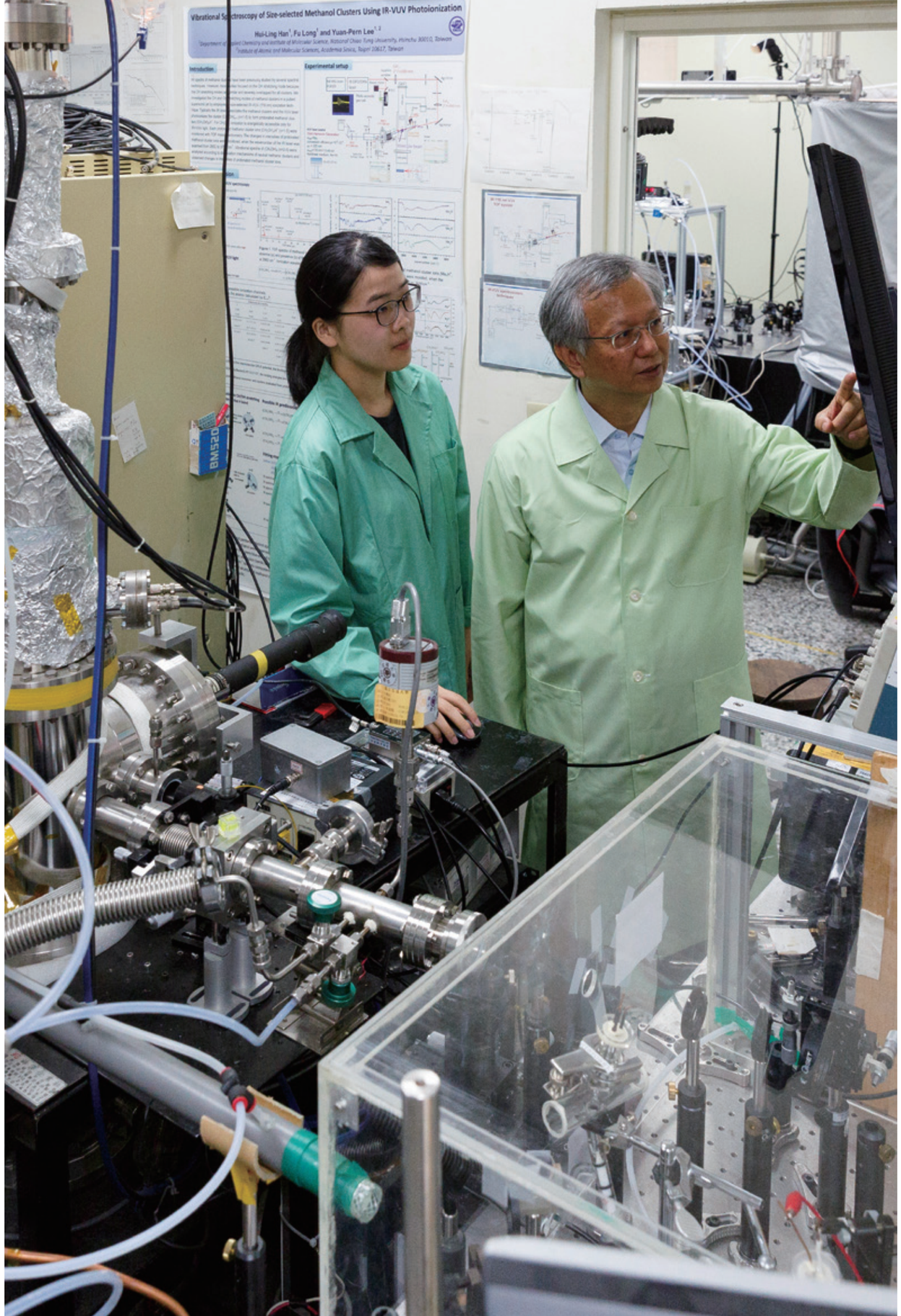
李遠鵬長年投入自由基研究，他解釋說，「自由基是指電子沒有配對，處於不穩定狀態的分子。由於它的活性大，就像班上最調皮的學生，會破壞搗蛋，到處與其他分子發生反應，在大氣化學、燃燒化學扮演重要角色。」

雖然這是探究自然本質的基礎研究，但卻與我們的生活息息相關。「例如，我們熟知的臭氧層破洞就是因為人類使用的氟氯碳化合物在大氣中經過光解會產生氯原子及含氯自由基，再與臭氧反應造成的。藉由從基礎了解問題的形成原因，才能提出解決之道。也因此，透過禁用氟氯碳化合物，現已證明臭氧層破洞正慢慢恢復中。」

特別是，近年來由於空氣汙染嚴重，除了臭氧層，像是氣溶膠、懸浮汙染物等問題，都使大氣化學的重要性日益提升。此外，自由基研究也與天文化學有關，因為宇宙星體蘊含著許多不同的分子組成，科學家需透過測得的光譜來推論其成分，所以需先在實驗室中做出相關分子的光譜進行比對，才能認定特定分子的存在，並進而了解各種分子是如何形成的。而生命的起源，也和外太空之分子如何漸漸形成胺基酸之類的產物有關。自由基在這些反應中也扮演重要的角色。

但由於自由基的生命期很短，若採用傳統方法，會因為速度太慢而無法偵測到它。因此，必須要想辦法使它的活性降低，或是利用特殊設備抓住它暫時存在的瞬間才有可能，而李遠鵬在這兩個領域都擁有一些領先全球的技術。

「間質隔離就是設法在極低溫把自由基關起來進行研究的一種技術。早期是利用惰性氣體來隔離，好比把壞學生放到四周都是



好學生的位置，讓他沒有人可以講話，不能再搗蛋一樣。而我們近年使用仲氫 (p-H_2) 量子固體做為新的間質，它有許多惰性氣體所沒有的優點。我們並發展質子化及氫反應新技術以應用於天文化學，獲得了豐碩成果。」為此，李遠鵬已於 2018 年獲得以他指導教授為名的 George Pimentel 獎，這是間質隔離研究的最高榮譽。

另一方面，為了以更快方式捕捉自由基，李遠鵬領先全球，率先發展步進式霍式轉換紅外吸收光譜儀的氣態研究技術，並利用此技術首次檢測到庫利基中間體（Criegee intermediate），證實了自 1949 年被提出，但從未被偵測到的，此大氣化學極重要之中間體是確實存在的。此研究論文於 2013 年發表在國際頂尖的「科學 (Science)」期刊上，引起各界重視。這項成果提供了監測及研究其相關化學反應的直接方法，不僅帶動此領域的研究風潮，也為大氣化學研究樹立了重要的里程碑。

屢屢獲獎　展現臺灣科研實力

從 1981 年回國迄今，李遠鵬獲得的學術榮譽不計其數，包括國科會傑出研究獎、化學會學術獎章、教育部國家講座，並當選美國物理學會會士、以及中央研究院第二十七屆院士，這次又獲得總統科學獎的肯定。國際獎項方面，2017 年的宏博研究獎以及 2018 年的 George Pimentel Prize 都是極高的榮譽。

對此，他表示，這一路走來，需要努力執著，且要求新求變，不斷地改進，並引進新的研究的方法，解決困難，才能成功。「這也意味著即使沒有船堅炮利的最尖端昂貴的儀器，我們還是有機會能夠做出別人做不出來的研究，無須妄自菲薄。同時，這也反映出，交大的研究環境是很不錯的，也能做出世界

級的研究，而且這些研究成果，也確實獲得國際肯定，受邀到各地的重要會議進行演講。當然，得獎不是因為我個人很厲害，這也歸功於歷年來政府、學校、我的學生、同事，以及太太的支持。」

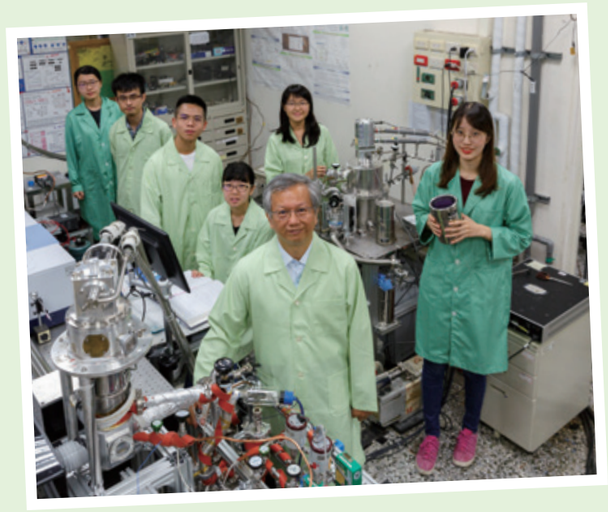
「儘管現在很多人投入奈米、太陽能等熱門領域，但大氣化學、天文化學都是非常重要的，科學研究不應有冷熱門之分，重點在於自己是能否精益求精，力求做到最好。」

對李遠鵬來說，研究工作本身帶來的成就感與樂趣，就是最大的報酬，其他的都是「副產品」，不是故意爭取得來的，好幾次獲獎，也是自然而來的。「例如，我於 2017 年獲得德國宏博基金會宏博研究獎，也是因為在一場研討會中巧遇一位教授，對論文內容相談甚歡，而因緣際會被推薦獲獎的。」秉持著求真求實的科學精神，使他能四十年來如一日的鍥而不捨追求進步，因而能在國內環境中孕育出世界一流的研究能量。

即使到現在，李遠鵬還是一週至少有兩天工作到半夜才回家，周六還跟太太請假，到學校上班，「我還曾經跟同事開玩笑說，每當覺得快要生病時，只要到實驗室就不藥而癒了。因為喜歡研究工作，轉移注意力之後，身體不適的感覺就不見了！」他笑說。「我要特別感謝太太。多年來，我一直是工作第一，太太不但完全支持，而且非常獨立能幹，照顧孩子處理家務，讓我無後顧之憂。我也從她那裏學到很多待人處事的道理。」李遠鵬夫人也是臺大畢業，取得西雅圖華盛頓大學病理生物學位後，回臺任教於元培科技大學檢驗科，已於數年前退休。

人才斷層　憂心經驗傳承

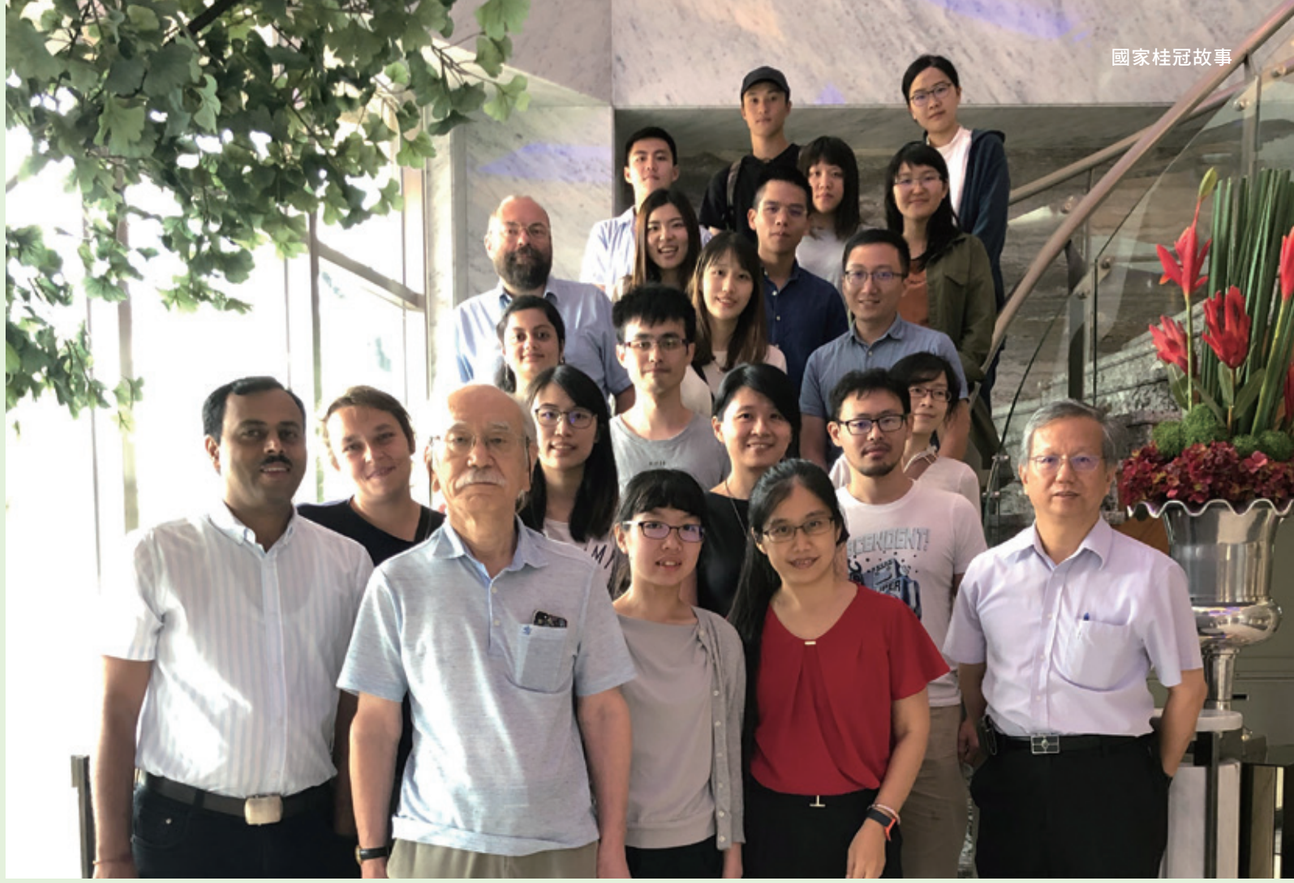
雖然李遠鵬在自由基領域的研究擁有豐碩成果，但現在卻對如何找到接班人把經驗傳承下去，維持國際領先地位，感到憂心忡忡。「記得在清華時，我的課都是座無虛席，連走道都坐滿了人，因為學生知道上我的課可以學到東西。而我也是傾囊相授，收集各家精華，準備了厚厚的講義，想把最好、最完整的內容傳授給學生。」



得天下英才而教育之，是君子之樂。李遠鵬自承對學生要求高，重視邏輯思考的訓練，「很多學生就業後回來說，雖然在學校老是被老師念，但就業後卻獲得長官稱讚，」他欣慰地說。「歷年來也有許多優異的學生，現在在同步輻射中心、工研院或業界任職，或是在清大、交大、中山任教，都有不錯的表現。」

不過，談到近年來學生素質的滑落，他說，「在網路、手機影響下，現在的年輕人也許有許多長處，但是多數已不太用腦，沒有深刻思想，也不讀書，失去了追求真理的興趣，確實是很嚴重的問題。」

「過去，往往是因為修我的課人數太多，而要限制學生人數。但現在，是別班要限制人數，因為修我課的人越來越少。」說到此，不免感嘆，「我不相信這是因為我教學退步的關係。現在的學生不讀書，自然也無從判斷老師的好壞，只求好過。以前，我是想辦法要把學生考倒，但總是有人考不倒。但現在，則是得多出考古題，把標準降低，但學生還是覺得難。若情況不改善，高階人才斷層後，以後可能連好的教授都找不到，尤其是在基礎科學領域。」



對李遠鵬來說，現在最大的問題是沒有學生要念博士班。曾經，門下有十幾個博士生的盛況已經不再，目前僅有的一位博士生還是在空了六、七年之後才好不容易收到的。反而是不少來自美國、德國、匈牙利的國外學生，因為受李遠鵬領先技術的吸引，來短期觀摩和見習，卻少有國內學生會因想學習此領先的研究而一心想進入其實驗室。

「學生變少，實驗室工作變得蠻辛苦的。沒有博士班學生，經驗就無法傳承。要維持世界領先的水準，很多事情是不能妥協的，所以我得花更多的時間在實驗室。」

「臺灣教育的填鴨與一致化，讓學子們沒有發現興趣與能力的機會，而且社會的世俗觀念也往往認為薪水最重要，這些都是需要改變的。我也曾經有少數幾個不錯的學生，因為寧願選擇到薪水更優渥的竹科上班，或是因為父母反對而不願留著唸博士班，非常可惜。」

他希望大家能同心協力來解決這個嚴重的問題，特別是中小學教育需要改變，讓學生更有思考用腦的空間，激發對求真求實的熱忱。而在大學，則是應該透過系統制度的建立，讓經驗能夠傳承，技術不會流失。例如，像日本的大學教授有副手制度，歐洲也類似，一個教授的職缺，事實上是包含了一個團隊，有技術員或副手在內，讓老師不再是單打獨鬥地孤軍奮鬥。

不忮不求　水到渠成

「對我來說，只要衣食無慮，薪水不應該是選擇職業的最重要考量。很多人雖然富裕，但生活的滿足感卻不見得好，這樣的人生並不一定值得追求，」他說。

「的確，不少學生就業後，雖然薪資遠比一般資深教授優渥，但生活品質卻不一定比較好。我常跟學生說，若對研究有興趣，當教授確實是不錯的選擇，不僅時間自由，而且實驗設備都是國家資助，不用自己出錢。能夠樂在工作，追求真理，解決問題，日日進步，這些成就感不是金錢能夠衡量的。」

自認不是那種「以天下興亡為己任」的人，不太在乎世俗，不汲汲鑽營，心願也很小，「因為我當初若是真的執著於要做最尖端研究，也不會選擇回臺灣了！雖然後來也是做到了。」

人生就是隨遇而安，但是每個階段、每個任務又都自我要求，親力親為，把事情做好。這樣看似簡單平凡的生活哲學，卻蘊藏著不凡的智慧。涓滴細流，匯成江河，讓李遠鵬的教學與研究生涯如水到渠成般的沛然充裕。

現已申請延退的李遠鵬，因為今年拿到為期五年的攻頂計畫，儘管到 70 歲就必須從學校退休，但其研究生涯還可持續到 73 歲。他將繼續投身於他最喜愛的研究，並期望能順利找到接班人，讓這好不容易在本土環境中孕育茁壯的自由基研究薪火，能夠繼續傳遞下去。

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成就事蹟 生命科學組— **陳垣崇** 院士

找出罕見疾病解方　拯救無數生命

返臺帶領中研院生醫所
促成臺灣躍升為基因體醫學研究重鎮

陳垣崇院士專長基因體醫學及轉譯醫學研究，投入肝醣儲積症、龐貝氏症、嚴重藥物不良反應及搜尋疾病的致病基因等相關研究。他研發出龐貝氏症治療藥物 Myozyme，獲准在世界各地上市。他並率領團隊找到藥物不良反應的易感性基因，透過用藥前預先檢測基因，可以預防嚴重藥物不良反應的發生。

陳院士成功發展出二種嚴重代謝性疾病的療法，成為目前該疾病的標準治療方法。其一是有效使用玉米澱粉療法，治療遺傳性肝醣儲積症所發生的嚴重低血糖症；其二是以酵素置換法，發展出有效新藥「Myozyme」，治療罕見疾病龐貝氏症，這是一種酵素缺乏疾病，會導致嚴重肌肉無力，進而心肺衰竭；發生在幼兒，嚴重者在 2 歲前即死亡。這個新藥的發明，拯救了無數原本無藥可救的生命。

陳院士團隊並找出數個會引起藥物不良反應的基因，使得某些嚴重藥物的不良反應可以事先被預防。例如針對致死率高達 40% 的二項嚴重藥物不良反應 - 史帝文生強生症侯群及毒性表皮溶解症進行基因研究，發現治療癲癇用藥 Carbamazepine 以及治療痛風用藥 Allopurinol 引起藥物不良反應的基因標記；以及針對廣泛使用的抗凝血劑 Warfarin 的使用劑量，陳院士團隊發現 VKORC 1 基因扮演重要角色，團隊進一步參與國際法華林 (Warfarin) 聯盟，並利用基因與臨床的數據演算出一個計算公式，能夠預測個人最理想的 Warfarin 用藥劑量，避免用藥後不正常出血的發生。

這幾項藥物基因體醫學研究成果，促使全球食品藥物檢驗局及世界主要的醫學會重新標示常用醫師處方藥 Warfarin、Carbamazepine 及 Allopurinol 的基因警語，並建議醫師在用藥前應先檢測基因，以預防病人發生藥物不良反應，使全球在藥物的使用上因此更為安全有效，同時帶領臺灣邁入個人化醫療及精準醫療的時代。

陳院士於 2001-2010 年接受延攬自美返國任職中央研究院生物醫學科學研究所 (生醫所) 所長，他將生醫所的研究方向重新定位為基因體醫學與轉譯醫學，積極推展國內及國際合作，促成中研院與國際藥廠葛蘭素史克藥廠及美國 Affymetrix 基因晶片公司建立策略聯盟，進行大型跨國合作計畫。在陳院士的帶領下，生醫所論文發表品質顯著的提升，研究成果發表在國際頂尖的科學期刊，至今已成為常態。2017 年起，陳院士積極協助生醫所進行精準醫療研究，將臺灣已經極為成功的基因體醫學研究帶入精準醫學的時代。

陳院士為臺灣建立大規模遺傳與基因體醫學研究及高品質的臨床研究。其創建學術界委託研究服務的機制（Academic CRO)，培訓國內專業遺傳諮詢人才，建立優良臨床試驗規範（Good Clinical Practice, GCP）準則，協助國內研究學者進行轉譯醫學研究。同時創建國家基因體醫學研究中心，提供國內研究學者及生物科技產業高品質、高通量及全方位的基因型鑑定服務，促使臺灣的基因體醫學研究成果斐然。臺灣也因此成為數個國際基因體醫學及生物資料庫研究聯盟的會員國之一，一躍成為世界基因體醫學研究重鎮。

陳院士對於國內罕見疾病團體極為關注，在罕見疾病基金會董事長及人類遺傳學會理事長任內，建立的遺傳疾病研究及病友照護機制，已是國際標竿，多國紛紛前來觀摩學習，也因此國際大藥廠發展罕見疾病新藥時，爭相在臺灣進行臨床試驗。

陳院士多項發明及專利授權 / 技轉給臺灣的公司。龐貝氏症治療方法授權給臺灣中橡公司，之後再技轉給 Genzyme 藥廠製成藥物 Myozyme，並在美國及歐盟獲准上市。藥物不良反應危險性評估的專利，技轉給臺灣世基生物醫學公司，成功製造出快速的檢驗試劑，已在世界各國應用在臨床上預防藥物不良反應的發生。他也以其豐富的生物科技經驗，擔任臺灣數家生物科技公司科學諮詢顧問，扶植本土生技公司，促進臺灣生技產業發展。

2010-2014 年間，陳院士創建並主持「中央研究院轉譯醫學研究計畫」，積極培育醫師科學家進行轉譯醫學研究，使實驗室發明的成果能進入多中心臨床試驗。陳院士也協助規劃「國家生技研究園區」，提供中央研究院在園區整體發展方向的專業意見，進一步推動臺灣生醫產業往前邁進。

研發罕見疾病解藥 救活原本無望的生命

敢於與眾不同的醫師科學家 戮力守護人類

一路走來，陳垣崇院士不以寂寞的研究為苦，他找到了罕見疾病的解藥，解救無數病患及他們的家庭；因為想要改善臺灣的不完美，他從美國回到臺灣，將臺灣打造成基因體醫學研究重鎮；即使是退休後，他依然心繫臺灣的精準醫療及預防醫療發展。

陳垣崇專長於基因體醫學及轉譯醫學研究，從事肝醣儲積症、龐貝氏症、嚴重藥物不良反應及搜尋疾病的致病基因等相關研究。他研發出龐貝氏症治療藥物 Myozyme，獲准在世界各地上市。他並率領團隊找到藥物不良反應的易感性基因，透過用藥前預先檢測基因，可以預防嚴重藥物不良反應的發生。

他領導中央研究院生物醫學科學研究發展成為亞洲知名的研究所，重新制定研究方向為基因體醫學與轉譯醫學，推展國內及國際合作。他並積極協助生醫所進行精準醫療研究，將臺灣已經極為成功的基因體醫學研究帶入精準醫學時代。

出身醫師世家　堅持走自己的路

陳垣崇出身醫生世家，父親是知名小兒科醫生陳炯霖，父母對於他的期望就是「當醫生」。他的學業成績也的確十分優秀，以第一名資格保送臺大醫科。在大學畢業前，他始終順服父母的期望，但是，在取得醫師資格後，他決定不再壓抑自己對於「研究」的熱情，他容許自己叛逆。

於是，他於 1974 年赴美，前往美國哥倫比亞大學人類遺傳系攻讀碩士和博士學位。在當年，人類遺傳學是非常冷門的領域。

從臺大醫學系到人類遺傳學研究所，這段路程並不容易，除了學業壓力外，陳垣崇必須面對親友的質疑、對於妻子的虧欠，以及經濟拮据的生活窘境，然而，無論困難及挑戰如何排山倒海而來，他不曾動搖自己的研究職志。

我們該慶幸他擁有如此堅定的意志及始終未被澆熄的研究熱情，才能找出罕見疾病的解方，拯救了許多原本不敢對未來抱有希望的病患及家屬；也謝謝他回到臺灣投身國人致病基因的研究及精準醫療的推動，讓臺灣在這些領域嶄露頭角，並造福更多民眾。

求學順遂　從小名列前茅

「其實，我在中學時最喜歡的科目是化學，我喜歡動手做實驗，看到不同溶液會變色、會起泡，這些都很能吸引我，」陳垣崇回想著他的求學路，「我本來是可以保送化學系的，但是終究不能如願。」他的話語中似乎還聽到遺憾意味。

家中及社會壓力使然，他仍舊進入醫學系就讀。不過，即使醫學系課業十分繁重，他還是找機會進入實驗室，每年暑假都泡在老師的實驗室裡，跟著老師做研究。「在我念到臺大醫科六年級時，當時全球出現第一個人類定序基因，我真的很好奇，我想要研究其中的奧妙。」他說。

「其實，我的個性比較內向，我不喜歡社交，從小就喜歡自己安靜地待著，」陳垣崇剖析自己的性格，他很了解自己的志趣所在，「當醫生就要和病人交流，我覺得並不適合自己。」

於是，醫學系畢業後，他不顧周遭親友反對，決定赴美就讀人類遺傳學，踏上研究之路。陳垣崇是該屆臺大醫學系的奇葩，全班唯有他一人轉進生醫研究領域。

「我的父母原本以為，我只要進了醫學系，就會忘記自己的研究夢想，沒想到七年過後，我還是選擇從事學術研究。」陳垣崇的聲音聽起來非常和緩平靜，但是話語傳達的執拗讓人無法忽視。

「當時我的母親很擔心呀！在她看來，當醫生是比較穩定的路，學術研究算是高風險行業，事實也的確是如此。」陳垣崇笑說。以他後來研究的罕見疾病龐貝氏症解藥而言，的確有可能在研究十餘年後一無所有，新藥的開發風險從來就不低。

全球第一個人類基因定序完成，吸引許多研究者投入基因研究領域，不過，大部分研究者選擇從細菌、微生物或病毒的基因切入。在研究領域的選擇上，陳垣崇再一次展現他的勇敢—敢於與眾不同。

「我想研究人類基因，尤其是和疾病有關係的基因，我喜歡進行大方向的研究，我不希望自己一輩子只是搞懂一個基因的功能或蛋白質結構等。」陳垣崇說。

美國許多大學皆設有微生物遺傳研究所，但這些並非陳垣崇的志願，他想研究的人類遺傳學，當時全美約僅有三至四所大學開設研究所，他全部都申請了，哥倫比亞大學首先回覆，就成為他的留學目的地。

留學生活苦　研究志向終不改

由於在大學時期就開始「自主」投入研究，所以，雖然是由醫學轉進遺傳學，但是他銜接得很好，僅花四年就拿到碩士和博士學位。

陳垣崇開玩笑地說，「也許是因為當時實在太窮了，所以想要早點拿到學位。」說是玩笑，但背後是真真實實的苦日子。成長在優渥的醫生世家，直到出國留學前，陳垣崇不曾擔心過經濟問題，然而，捨棄篤定可以名利雙收的醫生之路，他從決定赴國外留學的第一天起，就必須面對「錢」的問題。

妻子陪著他到美國留學，因為一開始實在很窮，他們曾在紐約街頭撿拾別人丟棄的傢俱；雖然陳垣崇就讀研究所有獎學金，但妻子還是必須去外面工作才能支應生活所需。

「當我的妻子嫁給我時，所有人都以為她要做『醫生娘』了，沒想到沒當成醫生娘，卻得到紐約辛苦上班。」言談中，可以感受到陳垣崇對於妻子的感謝，「她能夠體諒我對於夢想的追求，還願意支持我，我很謝謝她。」

妻子幾乎是陳垣崇念研究所的唯一支持。曾有友人至紐約拜訪陳垣崇，看見他們生活的困窘情況，不禁感嘆說出，「怎麼就沒有人幫你呢？」然而，就算是在這樣孤立無援的情況下，陳垣崇還是完成了他的學業，頗有「一簞食，一瓢飲，在陋巷。人不堪其憂，回也不改其樂。」的境界。

1978 年取得博士學位後，陳垣崇相繼在美國杜克大學醫學中心及美國衛生研究院 (NIH) 接受臨床住院醫師及遺傳醫學訓練。「因為遺傳疾病大部分是發生在小孩身上，所以我就再回去醫院完成小兒科的住院醫師訓練，這非常重要，我因此才能夠真正接觸到病人，以進行相關研究。」

完成住院醫生及遺傳醫學訓練後，陳垣崇的求學階段完成，總計二十八年，之後在 1983 年正式於杜克大學小兒部擔任助理教授，這是他的第一份工作，而他已經 35 歲。在同樣的年齡，他的臺大醫學系同班同學不少人已名利雙收。

他曾應臺灣雜誌媒體之邀參加一場座談會，到了會場，發現海報主題是《人生 30 歲賺到第一桶金》，他啞然失笑，當場和主持人說，「你們找錯講者了，我 35 歲才開始我的第一份正式工作呀！」陳垣崇說。

將研究轉化為治療方案　救治病患

在杜克大學，陳垣崇擁有了自己的實驗室，他全心沉浸在自己喜歡的研究中，如此七、八年後，他覺得自己的研究成果不該只能留在實驗室裡，而是希望這些研究能夠發展成為實質的治療方案，實際幫助病人。

然而，跨出實驗室並不容易，「學術界多認為發展藥物治療是藥廠的事，並非實驗室應該涉足的，但是藥廠只喜歡開發病患多的藥物，例如高血壓、糖尿病等等。」陳垣崇指出，做基礎研究容易拿到補助，臨床治療研究則不易獲得補助，偏偏藥物開發需要龐大資金投入。

「每五年寫一個計畫申請補助，然後等待退休，這不是我想要的人生。」他執意研究診斷及治療代謝性遺傳疾病的方法，他總是和大家背道而馳。也是因為他的堅持，過去幾乎是無解的問題獲得解決，為罕見疾病病患及家屬帶來了希望。

陳垣崇成功開發的兩種嚴重代謝性疾病的療法，已是目前該疾病的標準治療方法。其一是開發玉米澱粉療法，治療「遺傳性肝醣儲積症」所發生的嚴重「低血糖症」；其二是以「酵素置換法」發展出有效新藥「Myozyme」，治療罕見疾病龐貝氏症。

玉米澱粉奏效　造福肝醣儲積症病患

肝醣儲積症是一種遺傳代謝疾病，病患血糖降低時會出現痙攣，最嚴重甚至造成死亡。陳垣崇找到了治療方法，「這是非常簡單的方法，就是讓病患食用生玉米粉（經醫生調整劑量）。玉米粉是澱粉類，進入人體後會在腸道裡慢慢分解為葡萄糖並轉換為血糖，這就解決了血糖過低的問題。」這個簡單又便宜的方法，解決了許多病患的痛苦。

解開龐貝氏症謎團　拯救小嬰兒

陳垣崇成功開發的「先天性罕見疾病龐貝氏症」解藥，更是罕見疾病治療方法的一大突破，讓許多病童得以存活下來，也讓陳垣崇從此揚名國際。

龐貝氏症是一種酵素缺乏疾病，會導致嚴重肌肉無力，進而心肺衰竭。此疾病發生在幼兒身上，嚴重者在 2 歲前即死亡。

2006 年 4 月 28 日，陳垣崇研發的龐貝氏症解藥「Myozyme」，獲得美國食品暨藥物管理局 (FDA)）與歐盟醫藥品管理局 (EMEA) 核准上市。在世界醫藥史上，這無疑是值得特別註記的一天，而在迎來這一天之前，陳垣崇已經耗費十五年投入研究。

因為這項新藥的上市，全球每年上千名的龐貝氏症新生兒，將能擺脫「平均壽命六個月」的命運。陳垣崇也成為臺灣第一位從實驗室發展新藥，一路做到獲核准上市的科學家。

35 歲，陳垣崇成為杜克大學助理教授並兼任門診醫師。看診時，他發現被診斷出患有龐貝氏症的嬰兒，幾乎僅能等著死亡降臨。「開口告訴父母們這個壞消息—你們的孩子沒幾個月可以活了，這真的是很讓人受不了的事，於是我決心要找出解藥。」陳垣崇說。

當時並沒有太多人投入此項先天性罕見疾病治療方法的研究，一如既往，陳垣崇總是挑困難及冷門的路走。他踏上探求解藥之路，這一走就是十五年。

白天授課，晚上看診，然後就直奔實驗室投入研究。經過無數的熬夜研究時光，他知道龐貝氏症的起因，是由於患者天生缺乏分解肝醣的酵素，導致肝醣積存在肌肉與心臟裡，而造成肌肉無力與心臟肥大。

說得更詳細一點，龐貝氏症是第 17 對染色體基因異常，缺乏可分解肝醣的酵素，造成器官無法正常運作，發生率約二萬分之一。龐貝氏症症狀大致分為嬰兒型與晚發型兩種，前者約在 6 個月左右發病，常在 1 歲前就死亡，心臟、骨骼、呼吸、肌力均嚴重損害，心肺衰竭為最大死因。後者會在 2 至 60 歲發病，四肢無力，最終死於呼吸衰竭。

探究出龐貝症的成因後，陳垣崇的研究命題，就是要找到能進入肌肉與心臟的酵素。聽起來容易，其實很困難，因為分解肝醣的酵素只要一進入人體，就會被肝臟提前攔截吸收，酵素根本到不了肌肉與心臟。

該如何讓酵素能夠到達心臟和肌肉？陳垣崇想出的答案是：研發出的酵素必須帶著心臟與肌肉細胞能認得的密碼，酵素才能一路暢通無阻到達目的地。

1991 年陳垣崇開始帶領團隊尋找龐貝氏症的解藥，也就是帶有密碼的酵素。經過五年多的反覆試驗，他在倉鼠卵巢細胞發展出所需的密碼酵素，且在鳥類臨床實驗上證實有效。無奈的是，這項珍貴的解藥研究無法獲得大藥廠青睞，後續的人體臨床實驗無從進行。直到 1995 年，事情有了轉機。因緣際會下，經由當時杜克大學的同事，現任和信治癌中心醫院黃達夫院長的介紹，中橡公司董事長辜成允透過其轉投資的藥廠 Synpac 開始提供研究經費。後續更資助臨床試驗經費，使得第一次人體臨床實驗得以順利進行。

研究有所進展令人振奮，然而卻是一段痛苦旅程的開展。

臨床試驗對象是三個小嬰兒，分別編號為 101、102、103。試驗展開，前三個月，三個小嬰兒都順利存活，然而，半年之後，101 和 102 的體內出現排斥 Myozyme 的抗體，相繼在三年後死亡。探究原因，是因為這兩個嬰兒體內無法製造酵素，而產生抗體排斥作用，加上太晚接受治療，錯過了黃金早療期。

所幸 103 嬰兒活了下來。陳垣崇證明龐貝氏症患童只要在三個月內的黃金時期開始治療，並固定每個月兩次注射 Myozyme，就有機會像正常人一般。

沒有資格沮喪　病人在等著救命藥

這項研究長達十餘年，挫折很多，「支持我做下去的重要力量，是來自病人家屬的期盼眼神和鼓勵。」每當學生實驗做不出來，覺得沮喪時，陳垣崇會帶學生去看那些小小病人，「實驗做不出來，你可能就是晚一點畢業，但是對這些僅剩幾個月可以活的小孩子來說，可能就得面臨死亡。」陳垣崇藉此激勵學生千萬不要因為小挫折就放棄了，「我要他們體認自己在做的事情是非常重要，非常有意義的。」

人體試驗的成功還引起了一場風波。由於經費、藥量有限，陳垣崇團隊只能選擇三名受試者接受實驗，這導致其他心急如焚的病童家長抗議，美國白宮、參眾兩院都出面關切，美國主流媒體甚至有所質疑，陳垣崇曾因此投書紐約時報及其他媒體澄清。

一切波折過去，當初拒絕陳垣崇的大藥廠，在人體臨床試驗成功後展現投資興趣，並積極延攬陳垣崇到藥廠任職。

「我拒絕了，因為我是做研究的人，我是醫師科學家。」陳垣崇說。短短幾句話，道盡他對於自己理想純粹之堅持。

龐貝氏症治療方法後來授權給臺灣中橡公司，2000 年，美商健臻 (Genzyme) 藥廠決定向臺灣中橡買下專利，並在美國麻州及比利時蓋廠製造此藥。新藥 Myozyme 在美國及歐盟獲准上市，拯救了無數原本無藥可救的病患。最早於 1999 年接受此治療的一位病患，現在 20 歲了，已經是一位大學生。

這段跌宕起伏的新藥開發及一位父親為了替兩個患有龐貝氏症的孩子尋找救命新藥的故事，吸引美國華盛頓郵報記者吉塔的注意，他特別花了十八個月專訪陳垣崇及其他人並出書，好萊塢之後並將之拍成電影《愛的代價》。

電影中由哈里遜福特飾演科學家。「電影描述新藥開發的過程頗接近事實，不過，科學家通常是 boring 的角色，但考量戲劇張力，其實劇中角色的個性和我大不相同。」陳垣崇說。

應邀回臺　助臺灣生技醫療往前衝

成功開發出龐貝氏症新藥後，陳垣崇在 2001 年應中央研究院院長李遠哲的邀請，返臺擔任中央研究院生物醫學科學研究所特聘研究員兼所長。

在 2000 年，人類基因圖譜公佈，人類的全部 2 萬多個基因序列完成定序，這對於全世界的基因研究是重新畫了一條起跑線，在所有人都能掌握基因序列的情況下，現在要比拚的是誰先找到特定基因的功能，以及基因與疾病健康的關聯性。時任中研院院長李遠哲認為這是臺灣基因研究的大好機會，我們能與其他國家站在同一條起跑線上。

其實，陳垣崇在接獲李遠哲邀請前，他已計畫在杜克大學醫學中心展開相關基因研究，但是杜克畢竟是民間機構，籌集不到足以支應此計畫的龐大資金，而中研院能以國家計畫支持基因研究計畫。基於這樣的條件，陳垣崇回臺了解情況，「我當時其實不太樂觀，經費充足固然重要，但是臺灣當時有其他問題，人才、制度、法規的限制都可能導致研究無法順利展開。」

當時的陳垣崇疑慮重重，但是，李遠哲的兩句話打動了他。李遠哲說，「如果臺灣是完美的話，就不需要你回來了。」因為臺灣不完美，李遠哲回來了；因為臺灣不完美，陳垣崇覺得自己也應該回來。

他決定回臺任職，許多杜克大學同事認為他撐不過一年就會回來，但是結果證明他們錯了。他回來並留下，完成了許多大事。

進入中研院　打造基因體醫學研究重鎮

在 2001-2010 年任職中研院生醫所所長期間，陳垣崇將生醫所的研究方向重新定位為基因體醫學與轉譯醫學，他積極推展國內及國際合作，促成中研院與國際藥廠葛蘭素史克藥廠及美國 Affymetrix 基因晶片公司建立策略聯盟，進行大型跨國合作計畫。

延續對於罕見疾病的關注，陳垣崇在臺灣建立的罕見疾病研究及病友照護機制，已是國際標竿，多國紛紛前來觀摩學習，也因此國際大藥廠發展罕見疾病新藥時，爭相在臺灣進行臨床試驗。

陳垣崇並領導研究團隊找出多種常用藥物不良反應的易感性基因，讓藥物的使用更為安全有效，促使臺灣邁入個人化醫療及精準醫療的時代。

例如，針對廣泛使用的抗凝血劑 Warfarin 的使用劑量，陳垣崇團隊發現 VKORC 1 基因扮演重要角色，團隊進一步參與國際法華林 (Warfarin) 聯盟，並利用基因與臨床的數據演算出一個計算公式，能夠預測個人最理想的 Warfarin 用藥劑量，避免用藥後不正常出血的發生。這就是典型的個人化醫療。

此外，團隊還找出數個會引起藥物不良反應的基因，這使得某些嚴重藥物不良反應可以事先被預防。詳細的研究內容，是針對致死率高達 40% 的二項嚴重藥物不良反應—史帝文生強生症侯群及毒性表皮溶解症進行基因研究，發現治療癲癇用藥 Carbamazepine 以及治療痛風用藥 Allopurinol 引起藥物不良反應的基因標記。

這幾項藥物基因體醫學研究成果，促使全球食品藥物檢驗局及世界主要的醫學會重新標示常用醫師處方藥 Warfarin、Carbamazepine 及 Allopurinol 的基因警語，並建議醫師在用藥前應先檢測基因，以預防病人發生藥物不良反應。

也就是說，醫師在開立臨床用藥處方時，必須執行這幾項基因的檢測作業流程，以做為選擇用藥和劑量的參考。在這些研究成果的推動下，臺灣成為第一個實施全面性基因檢測的國家。藥物不良反應危險性評估的專利，也已技轉給臺灣世基生物醫學公司，成功製造出快速的檢驗試劑，世界各國已應用在臨床上預防藥物不良反應的發生。

退而不休　推動「臺灣精準醫療計畫」

陳垣崇已於去年 (2018) 年退休，現在一年中有半年時間待在臺灣，另外半年住在美國，他可以盡情看海並享受釣魚樂趣。「我很喜歡看著遼闊的大海，讓人覺得心胸廣闊。」陳垣崇自小就喜歡釣魚，退休後更有時間從事自己的興趣，像是他最近就常常到阿拉斯加釣國王鮭魚。

他也喜歡看書和看電影，「因為一輩子都在從事科學研究，我喜歡看充滿想像空間的科幻小說和科幻電影。」看海、釣魚、看書、看電影，可以看出陳垣崇就如他自己所言，他的確是內向安靜，擁有強大耐性和定力的人。不得不說，這樣的人格特質真的很適合從事旁人看來枯燥無比的學術研究。

陳垣崇的退休生活聽來愜意，然而他其實是過著「退而不休」的生活，仍然持續投入心力推動臺灣的精準醫療發展。

「我在去年正式退休，現在算是退到第二線，我的實驗室都結束了，學生也都已經畢業了，最近花比較多時間進行科普演講，也為年輕學者的研究提供一些建議。」陳垣崇說。

除此之外，陳垣崇還在協助推動臺灣精準醫療計畫。這個計畫由中研院生醫所所長郭沛恩主導，預計在臺灣收集一百萬人的資料，構成進一步發展精準醫療所需的大數據。「這個計畫要探討基因、生活環境對健康的影響，研究這些因素與個人疾病的關聯。」陳垣崇說明。

此計畫與全臺灣的所有醫學中心合作，陳垣崇扮演當中的串連角色。目前此計畫已收集十幾萬人的資料，以目前進度來看，預計三年內將可達到一百萬人的目標。

這個多達一百萬人的資料庫將帶來長遠的影響。至目前為止，人類還是無法徹底掌握常見疾病的病因，因為其中可能牽涉到基因、環境和生活習慣等因素，有了資料庫後，進一步分析出疾病與各種因素的關聯性，就能針對個體提出個人化醫療方案，這就是精準醫療。

不只如此，資料庫的大數據分析及研究，還能進一步將醫療從「精準醫療」推進至「預防醫療」。也就是說可以分析得知某人將來會得到心臟病、最有可能在幾歲得到心臟病，以及可能性有多大，這些都可以推算出來。

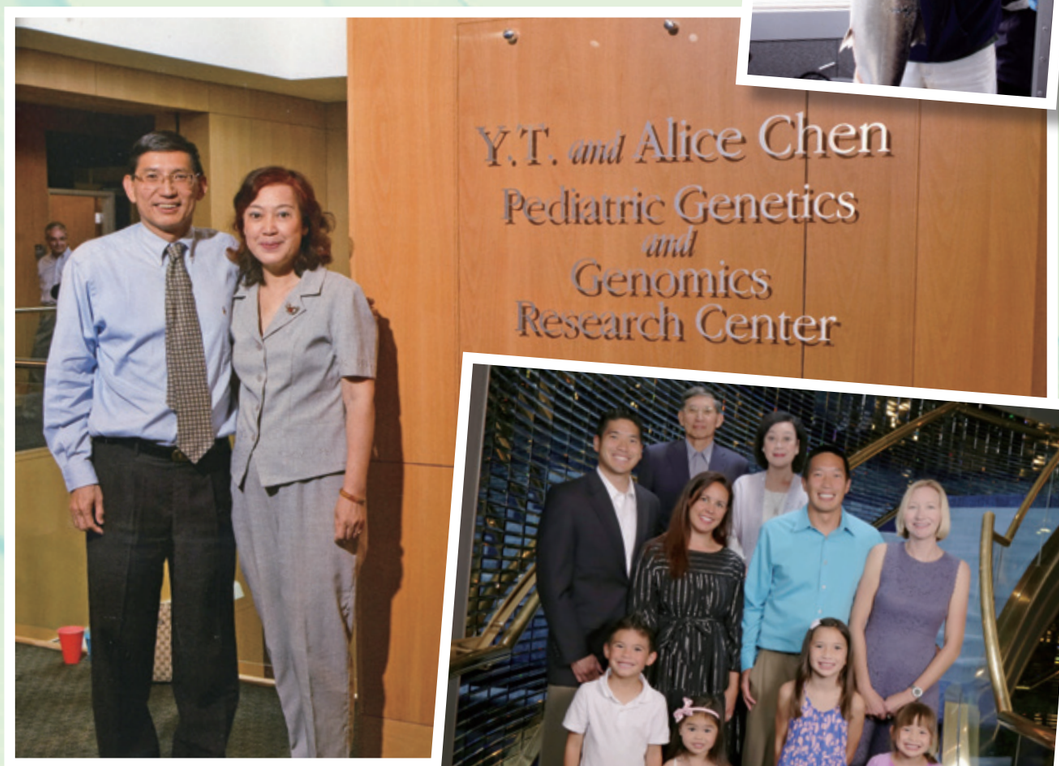
既然有可能事先預知將來會不會得病，醫師就可以建議病人及早改善自己的生活環境，以及飲食習慣及作息安排等，進而降低患病或發病機率，這就是「預防醫療」，猶如古代名醫所言，「上醫治未病、中醫治欲病、下醫治已病」。

臺灣有健保　發展醫療 AI 大有優勢

展望未來，陳垣崇提出他對於臺灣生技醫療產業的建議，「全世界都在談人工智慧(AI)，我認為臺灣的 AI 優勢是醫療人工智慧，因為我們有非常好的健保及醫療系統，多年下來收集到的電子病歷資料量十分龐大且完整，這是進行醫療大數據分析的前提，後續也才能發展醫療AI。」總而言之，憑藉全民健保系統，臺灣的醫療 AI 能跑得比其他國家快。

走過三十餘年，陳垣崇做為一位醫師科學家，無論在醫療及學術研究領域，皆留下了無比輝煌的成績。這些耀眼成果拯救了罕見疾病病患，讓他們擁有了原本不敢想望的未來，而他對臺灣醫療生技界的貢獻，不只讓臺灣成為全球基因體醫學研究重鎮，且持續推動臺灣邁向精準醫療及預防醫療領域。

有他這位巨人的肩膀，我們應能期望後繼的臺灣科學家能因為站在高處，而能看得更遠，破解更多的疾病謎團，為人類健康提供更好的守護。



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成就事蹟 應用科學組— 魏福全 院士

最具影響力重建外科醫師 享譽全球

深耕自體及異體移植研究　造福無數病患

中央研究院院士魏福全教授，四十年來帶領其建立的研究及醫療團隊，致力於自體及異體組織移植的相關基礎與臨床研究，其領域涵蓋移植組織的缺氧再灌注傷害、微循環的正常及病態生理、移植供應及接受處之生物力學、異體移植之動物模式、免疫調控、神經恢復以及臨床移植功能與外觀的最優化。

由於這些研究的先驅性、獨特性及深入性，魏教授的學術成果輝煌，在國際外科界受到高度推崇，可見證於 2006 年被美國整形外科學會選為「整形外科四百年歷史上二十名創新發明者之一」，並譽其貢獻為「將傳之世世代代」、2007 年被德國選為史上百大手外科學者、2014 年為世界頭頸腫瘤學會選為推動頭頸癌治療進步的百位推手之一，以及 2015 年同時被美國整形外科學術評議會 (ACAPS) 及美國東南區整形外科學會 (SESPRS) 選為當代十位最具影響力的重建外科醫師並名列前茅。2017 年起世界重建顯微外科學會更設立了 “Fu-Chan Wei Award” 唯一以人名所設的獎項，每兩年在大會頒給對世界重建顯微手術發展有重大貢獻的人。

魏教授在學術上的成就可具體見諸於他質量俱佳的著作。魏教授發表於國際期刊的論文近 500 篇、教科書章節 120 章、文章被引用近 15,000 次、在國外出版的專書共有 18 本，其中 2009 年初版的《Flaps and Reconstructive Surgery》共有英文、西班牙文、葡萄牙文、及簡體中文四個版本，為當今此領域最暢銷的書，而其 2016 年版更榮獲英國 British Medical Association 2017 年 Medical Book Award 外科類的首獎。魏教授也曾擔任國際顯微手術雜誌主編、美國整形外科雜誌國際副主編，目前為十多種期刊的編輯委員。

魏教授這些學術上的傑出貢獻，使其幾乎囊括其領域國內、外所有相關學會所頒的最高獎項及榮譽，並應邀擔任許多重要演講及 80 多個著名大學的客座教授。魏教授更於 2012 年當選中央研究院自 1928 年成立以來第一位外科院士。

魏教授經由研究，創新發展一列系用以重建殘缺手指的腳趾移植；用以重建四肢骨骼及上、下頜骨的腓骨骨皮瓣；以及用以一次性重建身體各部位缺損的各式皮瓣。這些成果廣泛應用於臨床，大大提昇了頭頸癌、乳癌、肉瘤及其他腫瘤的可切除性、以及殘缺肢體的可重建性；改變了當今外傷及癌症外科治療的風貌及成果並成為世界上重建顯微手術的主流。

魏教授與團隊所發展的重建手術，在魏教授的醫學中心已挽救了三萬多名病患，國內其他醫院專家直接或間接利用從其學到的知識與技術進行同類手術，估計應五倍於此，在世界各國更是不計其數。

由於魏教授的熱心教學、質量俱佳的論著，以及積極參與諸多相關國際學會組織並擔任重要職位，魏教授所服務的醫院及大學享譽全球，榮為美國重建顯微手術學會推薦的訓練中心、為該領域專家譽為必訪的聖地麥加。從 1980 年末期至 2018 年底，已有來自 85 個國家共 2,228 位專家學者前來向魏教授學習，其中以美、英、韓、德、日、泰、印最多，且至少已有上百位曾受魏教授訓練的醫師已成為教授、主任或為該國甚至國際上的權威學者，堪稱桃李滿天下。

魏教授更於長庚醫院及長庚大學設立全球唯一「顯微手術國際研究員訓練」合併 「顯微手術國際碩士學位學程」，三年內已有 18 位外籍醫師畢業。此外，由於魏教授對於新科技的熱烈追求與不懈努力，其團隊成員也在國內完成第一至第四例的「異體手術移植」，魏教授的 2 位美國學生也已分別在約翰霍普金斯，紐約大學及 Mayo Clinic 完成四例「異體臉移植」。

綜合上述魏教授在學術上有非凡成就，其聲譽在其領域早已領先世界，並在國際上受到高度尊崇，魏教授能善用研究資源並將成果充分應用於臨床，造就當今癌症及外傷治療的新進展，落實了轉譯研究的精神；其創新的學術理論與術式不僅在臺灣，更是普及全球，已成功地挽救無數的生命與健康，更重建他們的功能與外觀，維護了他們生命的尊嚴，也減少了家庭及社會國家的負擔；魏教授訓練了如此多的國內外學生，並在世界重建外科界產生長遠及重大的影響。魏教授的整體表現極為傑出，集研究、應用、教學、服務、國民外交於一身。

深耕整形外科領域 以顯微手術重建病人尊嚴

中研院首位外科醫師院士 影響力遍及全球醫界

魏福全院士是優秀的外科醫師，也是傑出的科學家，他的貢獻造福無數世人。數十年來，魏福全專注於顯微整形重建外科，他的研究成果普遍應用於臨床，改變半世紀以來外科的內涵與風貌，大幅改善重建後的功能及外觀，對於嚴重大面積的外傷，由於擴大切除癌症病灶而產生的身體組織的缺損的重建有極大貢獻。

魏福全帶領建立的研究及醫療團隊，致力於自體及異體組織移植的相關基礎與臨床研究，其領域涵蓋移植組織的缺氧再灌注傷害、微循環的正常及病態生理、移植供應及接受處之生物力學、異體移植之動物模式、免疫調控、神經恢復以及臨床移植功能與外觀的最優化。

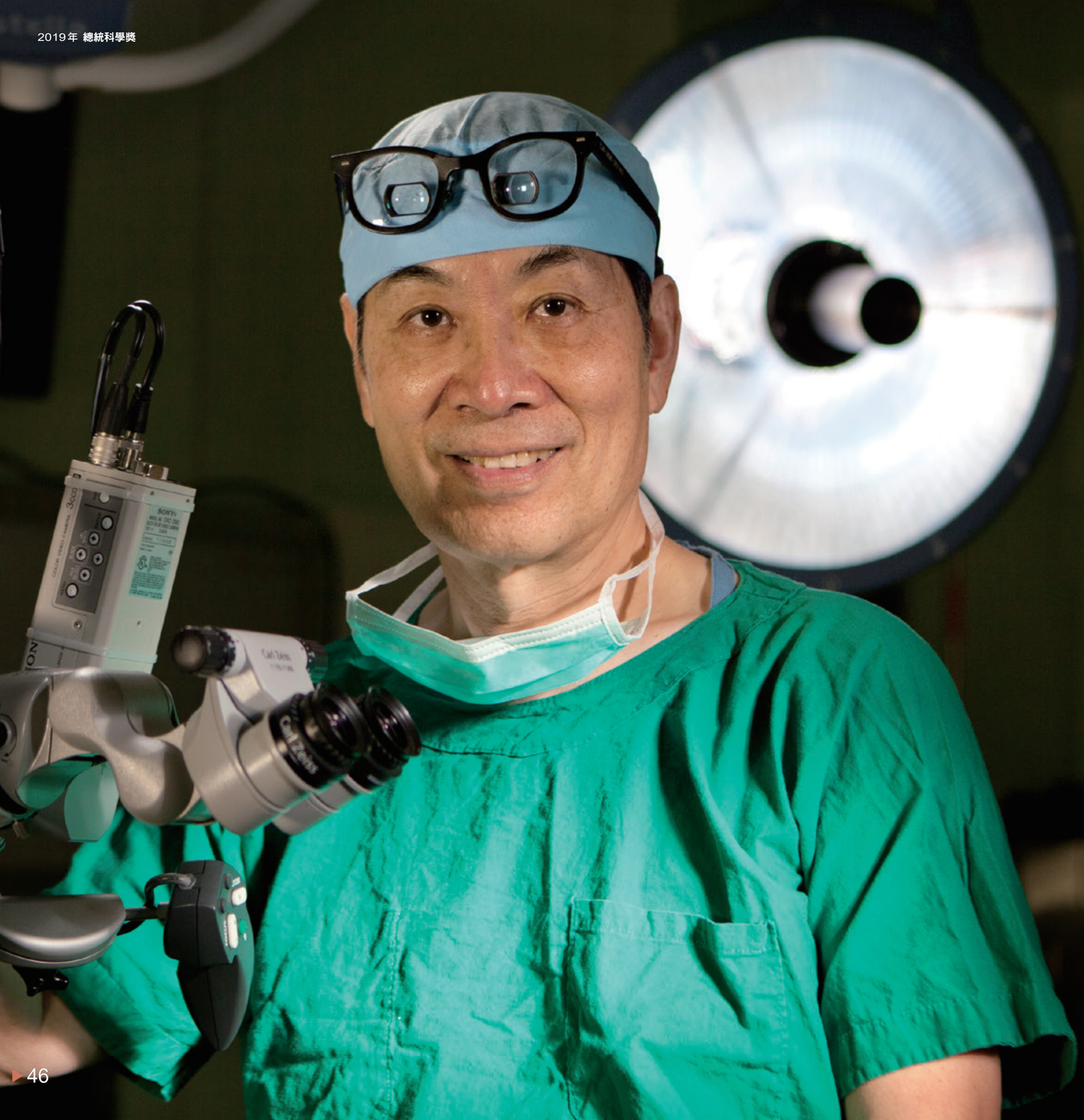
魏福全亦是一位成功的教育家，過去數十年不僅在國內更為國際上 87 個國家訓練了超過 2200 多位此領域的專家醫師，其中許多都已在其國家成為該領域的領導者。長庚因而被譽為全球顯微重建界的「麥加」，讓世界見識到臺灣尖端外科醫療的成就。

父親身教耳濡目染　從小喜愛閱讀

魏福全踏入醫學之路似乎是理所當然的，在 1970 那個年代，學業成績最頂尖的臺灣學生，幾乎都是選擇就讀醫學系，他也不例外。

「因為父親的身教，我們家的小孩都很喜歡念書。」魏福全非常敬佩父親，他的父親因為家庭關係無法繼續升學，然而，僅有中學學歷的父親非常喜歡閱讀，他在經營海、山產批發生意之餘總是捧著書的身影，是魏福全成長過程中的鮮明記憶。

「父親每天晚上回到家後，就陪著我們這些孩子一起在擺滿書桌的客廳裡閱讀、寫作業，他不太外出，沒有什麼娛樂，也鮮少應酬。」在父親以身作則下，魏家孩子一女四男中，有三位畢業自醫學系、一位畢業自藥學系。



挫折轉換成養分　滋養他的成長

看似順遂的求學過程，魏福全其實也不是完全一帆風順。由於是家族長孫，在祖父的堅持下，他不能像其他弟妹一樣去他心目中的高雄完成中學學業，而必須留在屏東求學。不過他仍憑著優秀的成績在高三下取得保送成功大學電機系的資格；「確定被保送後，我就整個放鬆下來，沒想到我的祖父和父親卻突然要求我去考醫學系，在沒有充分準備，加上考試當天感冒發燒的情況下，結果不如意，只得等一年重考才順利考進醫學系。」魏福全說。

對當年十幾歲的他來說，這是個大的挫折，然而現在回想起這個人生關卡，他覺得當初把事情看得太嚴重了，「其實後來在工作上經歷的挫折更多，但事後回頭看，會發現這些挫折或已轉化成滋養人生的養分，甚至是機遇。」魏福全舉例說如他自高雄醫學院醫學系畢業後，雖然學校成績不錯且自信能考上馬偕醫院擔任外科住院醫師資格，沒想到第一次也遭到滑鐵盧。但是失望並沒打倒他去馬偕學習整形重建外科的意志，他在高雄醫學院附設醫院當完住院醫師一年後再次申請才得順利。然而挫折再度來臨：馬偕不允許他銜接擔任第二年住院醫師，必須以第一年住院醫師的資格重新起步，「我當時很逆來順受呀！就默默接受了。」正所謂「塞翁失馬，焉知非福」，由於他其實已經歷練過一年的住院醫醫師生活，所以在同梯次醫師中顯得比較成熟，也較能解決問題，因此他比其他人較有機會表現，也容易受到提拔。

感恩前輩提攜　努力超越

在馬偕醫院，帶領魏福全進入整形重建領域的老師是陳明庭教授 – 他是臺灣第一位於美國接受完整整形外科住院醫師訓練的醫師，目前尚在國泰醫院服務；此外，於 1970 年代進行臺灣首次斷指再接手術的蔡智民教授也是他最敬重的導師。

在馬偕醫院期間，魏福全有幸接受羅慧夫醫師的教導，結下畢生的師生緣分，也影響他此後數十年的生涯。羅慧夫在臺灣四十年間造福臺灣無數顱顏傷殘及兔唇顎裂病患。長庚醫院 1976 年成立後，羅慧夫應邀出任創院院長，魏福全也在老師的要求下一起來到長庚醫院。

1990 年擔任長庚醫學院外科教授、1994 年出任整形外科科系主任、2003 年升任長庚大學醫學院院長、2011 年擔任長庚醫院異體複合組織移植中心主任直到現在，三十年以來，魏福全在長庚展開他的輝煌事業，並與同仁共同努力將長庚醫院打造為全球整形重建外科醫療重鎮。

值得一提的，魏福全在 1990 年末期分別在擔任國際重建顯微手術醫學會秘書長及國際顯微手術醫學會時，促成二者合而為一的世界重建顯微手術醫學會，並於 2001 年在臺灣舉辦第一次大會，盛況空前，奠定了此一學會當今的茁壯。由於魏福全是促成此新學會的關鍵人物之一，且其學術成就再加上他訓練最多位重建顯微手術專家的貢獻，學會於 2017 年決定以魏福全為名設立 Fu-Chan Wei Award 獎項，在兩年一度的大會中頒發予該領域中貢獻最為卓著的人士。

赴美國學習
帶回臺灣沒有的知識和技術

談起當初為何會踏入重建顯微外科領域？魏福全分享一段秘辛。1979 年，時任長庚整形外科主任的羅慧夫醫師，派魏福全到加拿大多倫多大學附設醫學中心整形外科進修。但是對於要學習什麼？羅慧夫告訴他，「你去學習臺灣沒有的東西，為臺灣帶回新知識和新技術。」帶著老師的「指示」，初到多倫多大學附設醫院的第一個月，好奇的他發現很多新東西，什麼都想學。

直到有一天，他的指導教授林西 (Lindsy) 問魏福全，「你到底對什麼領域特別有興趣？」當時英文還不是很好的魏福全，情急之下只想到一個英文字 “microsurgery” (顯微外科)。這個回答，決定了魏福全此後數十年的專業領域，也造就了一位影響力擴及全球，造福無數病患的重建顯微權威人物。

建立臺灣首個顯微重建團隊
超越世界水準

顯微手術高度精密，眼力、體力、純熟技術缺一不可，一檯手術至少需 8 個小時有時甚至需要超過 12 小時。1981 年，學成歸國的魏福全立刻在長庚成立臺灣第一支常規服務的顯微重建醫療團隊。

臺灣當時正處於工業起飛年代，工廠林立，雖然創造了臺灣經濟奇蹟，但勞動安全環境不完善，因此職業災害、肢體傷殘事件頻傳，剛好用得上進修時所學的顯微手術技術，加上當時有勞保給付，只要醫師願意吃苦耐勞，不必為病人太擔心顯微手術的龐大醫療費用，這給了魏福全很多的機會救治這些肢體傷殘的病患，讓他們能夠重拾工作能力，而他自己也在短時間內累積豐富治療經驗。

隨著時代變遷，1990 年代起，臺灣工業逐步轉型，肢體傷害也逐漸降低，因此顯微重建手術也隨著轉移應用於癌症腫瘤切除後的缺損重建，使顯微手術在重建外科上益顯重要，終至成為當代之主流。

魏福全對自己的自信是建立在逐步不斷並小心的印證上，雖然他在回國第三年的 1983 年代表羅慧夫參加第一次國際會議時已

感覺到自己的水準似乎已不輸他當時心目中景仰的前輩，但他並不敢武斷，「在沒有多方比較之前，我就不能完全相信自己做得比人家好。」他說。

基於這樣的心態，魏福全積極把握每一次參加國際醫學會的機會發表手術與研究成果，直到 1990 年初「我與頂尖整形醫師同台，和他們互動討論，才敢較自信的認為我們的水準與成就已達到、甚至是超越了世界水準。」他說。

首創顯微重建手術專用加護病房 提升術後照護品質

由於顯微重建病例數迅速增加，為了提高術後照護水準，魏福全在 1984 年在院方協助下提出成立顯微重建手術加護病房，1988 年更在王永慶董事長及張昭雄院長支持下擴充為 24 張病床。之後事實也證明，這是一件非常成功而且具前瞻性的壯舉，因為他不僅大大的提升了顯微重建術後的照護品質，也成為一個床邊教學及蒐集資料從事研究的絕佳場所，到目前已收治病患及超過三萬多個病例，長庚顯微重建手術加護病房的名氣自 1980 年代即已舉世皆知，如今則仍傲視全球。

「利用顯微手術技術吻合上血管和神經後，後續還要觀察血液循環是否通暢，否則之前動手術所花費的時間都白費了，所以重建外科專屬的加護病房非常有必要。」魏福全說明。目前約有 6% 的顯微手術出現術後血管阻塞的情況，但如果能及早發現再接通一次，其中八成還是可以挽回的。

當選中研院院士　鼓舞臺灣外科醫界

一路走來，魏福全獲得的榮耀幾乎不可勝數，其中，對於自己能以外科醫師身分當選中研院院士，他曾直言，「這是我這輩子最大的光榮」。魏福全於 2012 當選中央研究院士，這是中研院自 1928 年成立以來的第一位外科臨床醫生院士。

正所謂「有為者亦若是」，他的當選鼓勵了許多同行及年輕醫生。「得獎消息確定後，我的外科醫生同事都很興奮呀！他們很高興外科終於被認為是在做科學研究。」魏福全直言過去的學術界都認為外科醫生是技術工作，「在他們眼裡，我們的層次好像低了一等，我的入選扭轉了這件事，讓臨床醫生的重要性獲得肯定。」他也提到轉譯醫學的重要性，「不管你的研究做得多好，如果沒有辦法轉換成對人類有益的東西，就大打折扣了。」

由於魏福全的研究擁有很多的創新目前都已成主流觀念與技術，在國際上獲獎無數受到極高尊崇的事實，因而獲得許多院士肯定；終而能讓他加入這個學術界的殿堂。

「中研院的院士大部分都有博士學位，我只有大學畢業，這也給了年輕朋友一點啟示，」魏福全說道，「只要你腳踏實地，願意努力專注提升自己的學術能力，總是有機會被看見的。」魏福全常常擔任博士生的口試教授，他的父親有一次調侃說道，「你真的是博士學生的老師嗎？你只有學士呢。」不過，要特別提到的是，其實魏福全曾於 1979 年、1983 年分別到加拿大多倫多大學及美國路易維爾大學進修。

無數榮耀加身　著作等身

無數榮耀加身，魏福全的醫療及學術研究成果備受全球外科界推崇。2006 年，美國整形外科學會選出整形外科四百年歷史上的二十名創新發明者，魏福全列名其中，且其貢獻被盛讚「將傳之世世代代」。

此外，2007 年被德國選為史上百大手外科學者、2014 年被世界頭頸腫瘤學會選為推動頭頸癌治療進步的百位推手之一、2015 年同時被美國整形外科學術評議會 (ACAPS)，以及美國東南區整形外科學會 (SESPRS) 選為當代十位最具影響力的重建外科醫師並名列前茅。

雖然他經常忙著開刀服務病患以及教學研究並不時全球各地發來飛去，根據資料他應邀參加的國際會議與獨立課程講座已累積 100 多次，國際研討會演講與大學邀請特別演講幾近 700 次。但是他依然可以產出許多高品質著作。我們來看看以下驚人的數據：發表於國際期刊的論文近 500 篇、教科書章節 116 章、在國外出版的專書共有 18 本、文章被引用近 15,000 次。

特別值得一提的，其中 2009 年初版的《Flaps and Reconstructive Surgery》 共有英文、西班牙文、葡萄牙文、及簡體中文四個版本，為當今此領域最暢銷的書，而其 2016 年的第二版更榮獲英國 British Medical Association 2017 年 Medical Book Award 外科類的全球首獎。魏福全也曾擔任國際顯微手術雜誌主編、美國整形外科雜誌國際副主編，目前為十多種期刊的編輯委員。

受邀至哈佛大學擔任客座教授

開完刀後立刻記錄　累積上萬筆資料

身為重建顯微外科醫生，一檯手術至少要耗費 8 個小時，魏福全到底是如何完成這麼豐碩的學術成果？他的時間管理方法讓人十分好奇。

在採訪中被問及這個問題，魏福全起身走向辦公室一側的鐵櫃，他打開其中一個抽屜，裡頭是滿滿的檔案夾，分門別類整理得妥妥當當，「這是我為病人動過的每一次手術的詳細紀錄。」這是魏福全據以產生高水準論文、著作等作品的寶貴資料庫。

「在演講場合，我常常建議外科醫生要有記錄習慣，例如開刀的緣由、過程中遇到的問題、後來的結果等等，愈詳細愈好，日後進行分析時才能有理有據。」魏福全說。

即使知道整理和累積資料的好處極多，然而在完成一檯約十小時的開刀手術後，外科醫師早已精疲力盡，在此情況下還要立即花上半小時記錄資料，非得要有過人的意志力才能做到，「一定要在手術後立刻記錄，否則之後的記憶會有缺失和錯誤。」從 1981 年開始，魏福全就是這樣完成一筆筆的記錄，至今已累積上萬筆，相當驚人。

從手寫到電腦輸入，魏福全堅持著記錄一筆筆資料，近年多了住院醫師和助理的幫忙，他仍會要求在兩天內完成所有影音資料的歸檔整理。歸納魏福全的時間管理哲學，「即知即行，鍥而不捨」這八個字應能忠實表達。

打造重建外科聖地
吸引全球醫生前來朝聖

一路走來，魏福全始終兢兢業業，他不斷追求進步，「一開始的七、八年間，我只敢說自己在這個領域是 “one of the best”；再過了幾年，我才覺得應該已進步到 “the best”；之後又努力了很久，才敢肯定自己是 “unique” 的。」魏福全對 “unique” 的定義是研究具有前瞻性，對世界有影響力。魏福全的確做到了。

魏福全在國際型重建顯微領域擁有極高聲望，加之他總是不藏私地與同業交流，因此許多人將他任職的長庚醫院視為重建顯微外科領域的「聖地麥加」，一生總要來朝聖一次，藉以增加自己的功力。前美國哈佛大學整形外科主任古德溫 (Goldwin) 就曾說過，「整形外科醫生若沒有到過臺灣的長庚醫院，就不算完成整形外科訓練。」

將魏福全所在之處比喻為聖地，這樣的形容並不誇張，數據就可說明一切：從 1980 末期至 2018 年底，已有來自 85 個國家共 2,228 位專家學者前來向魏福全學習，其中以美、英、韓、德、日、泰、印最多，且至少有上百位曾受他訓練的醫師已成為教授、主任，甚至成為該國重建顯微領域的代表人物。

為了讓更多人受惠，魏福全授於長庚大學設立全球唯一「顯微手術國際碩士學位學程」，三年內已有十八位外籍醫師畢業，也計畫推動博士學位學程，與先進國家大學進行雙聯合作。

魏福全對全球重建顯微手術的發展影響至深，也讓臺灣的尖端醫學發展揚名國際。

醫術高超　譜出無數動人故事

魏福全最著名的三大手術創新高招，分別是：利用腳趾移植來重建殘缺手指；利用腓骨骨皮瓣來重建四肢骨骼及上、下頜骨；以及利用各式皮瓣來一次性地重建身體各部位缺損。這些成果廣泛應用於臨床，已成為世界上重建顯微手術的主流，改變了現今外傷及癌症外科治療的風貌。

動過無數手術，想請魏福全挑出其中一個感人病例其實非常強人所難，不過他還是

說了一個小男孩的故事。二十年餘年前，有一個 5 歲小朋友因為手燙傷，導致兩隻手掌都被切除了，他沒辦法自己喝水、上廁所，日常一切都需要父母照顧協助，非常可憐。「後來他被父母帶來找我，檢查過後，我發現他剩下的手部肌肉仍有收縮動作，判斷這是可以重建的。」魏福全說。

於是，魏福全從小男孩的左腳取下兩根腳指頭，右腳取下三根腳指頭，將之重建右手的三根手指及左手兩根手指，「重建後的效果很好，他現在已經大學畢業且開始上班了。」魏福全分享他行醫生涯中無數故事的一個縮影。

魏福全的研究充滿原創性，這些成果大大造福頭頸癌、乳癌、肉瘤及其他腫瘤病患，讓他們能恢復切除部位的功能及外觀，「我們重建的不僅是病人的身體缺失，我們重建的還是他們的尊嚴。」魏福全強調。

例如，有些乳癌病患因會害怕切除乳房後有損自己的女性形象，所以遲遲無法決定切除病灶，但現在手術水準很高，可以將缺損重建得很好，「病人對醫生有信心，及早接受切除手術的意願提高，就不會因為延遲導致病況惡化，且術後能夠恢復外觀，病人不用面對外界異樣的目光，可以有尊嚴地生活。」魏福全說。其他像是舌頭、下巴等都可以重建，這對病患而言是足以轉變生命的關鍵。

魏福全執行的精細重建顯微手術及其背後動人的病人故事，廣為 Discovery、National Geographic 頻道、The Atlantic、讀者文摘中、英文版等美國、英國、香港、臺灣各電視頻道及重要平面媒體所報導，也因而吸引許多國際病患遠道而來求醫。

研究「異體移植」 累積成功案例

因為好奇踏進顯微重建領域，魏福全從此未曾停下學習、探索、創新的腳步。近年他投注心力研究「異體移植」，且有大有成果。

異體移植的完整名稱是「複合組織異體移植 (Composite tissue allotransplantation)」。不同於一般的移植重建手術是取病患本身部位來修補缺損，異體移植則是取他人或動物部位進行修補。

基本上，「複合組織移植」技術與斷指再接差距不大，同樣包括接血管、接神經等顯微重建技術，關鍵在於病患術後的免疫抑制藥物使用問題，例如，異體移植皮膚的排斥高於腎臟，也高於肝臟，而患者長期使用抗排斥藥物壓抑自身免疫時，可能提高糖尿病、腎衰竭，甚至腫瘤發生的機率。這些都是醫生必須全面考量的問題。

長庚醫院的異體複合組織移植中心成立於 2001 年，由魏福全擔任中心主任。「我們研究手和臉的移植，在實驗室裡已將黑鼠的臉移植到白鼠身上，持續取得進步。」魏福全進一步說明，「我們要查明排斥的原因、採用哪種幹細胞治療較不易產生排斥，如果成功存活我們想知道移植組織的功能恢復，譬如老鼠的鬍鬚何時會動、老鼠何時會有反射反應等。」在忙碌的開刀及門診之外，魏福全帶領著由三位博士及多位科內醫師組成的團隊投入研究。

不斷克服挑戰，魏福全與團隊成員已在國內完成四例「異體手術移植」，而他的兩位學生也已分別在霍普金斯紐約大學及 Mayo Clinic 完成三例「異體臉移植」。

全球顯微重建學生組成 "Fu-Chan Wei Club"

臺灣於 2017 年完成的首例雙臂移植手術，其負責醫師林承弘就是由魏福全派至美國學成回國。手術費用由長庚醫院的研究計畫經費支付。這次手術由長庚異體複合移植中心團隊共二十名醫師、歷經十三個小時完成。這是全球四肢截肢進行雙臂移植的第十一個案例。魏福全並透露該中心近期應該就會進行人臉的異體移植手術。

「我們持續推進異體移植研究，但是不會躁進，且要遵守醫學倫理，實驗一定要在良好監督之下進行」，魏福全非常強調病人的利益永遠是最優先的考量，絕對不能因為要搶先成功，就讓病人承擔風險，「我們很謹慎，非由病人主動向媒體曝光，長庚從來不針對異體移植手術的成功進行發表。」

熱衷吸收新知　與時俱進

想要在研究領域揚名立萬，好奇心是不可或缺的要素，魏福全是非常好的例子。他積極吸取新知，對許多事物都想要有所了解。「尤其是醫學比較接近科技，所以，我對於科技知識的渴望很急迫，甚至有一點焦慮，一旦覺得自己落伍了，就會覺得不自在，所以就算時間有限，我還是極盡所能吸收知識。」魏福全最近對 5G、AI 和醫療的結合頗有興趣。他吸收新知的管道除了紙本雜誌、書籍外，近年也開始仰賴 Youtube 影片及有聲書瞭解這個世界。

魏福全關心許多當代議題及趨勢，臺灣醫學的未來當然更是他關注的重點，「臺灣醫療水準很高，但是真正能擁有世界影響力的領域並不多，我建議政府應針對臺灣實力最強的幾個領域，集中投入更多資源，才能拚出足以傲視全球的成績，而透過這些領域的帶動效果，臺灣整體

醫界將能進一步躍上國際舞臺。」這是來自一位頗負國際聲望的醫師提出的誠心建議。

改變病人生命　改變世界

魏福全的行程總是很滿，直到今年年初因為患上心肌炎，八月又出現胃出血，他的步調才稍稍慢了下來。即便如此，在距離他治療胃出血院出院後不到一個月的時間內，他仍然與團隊完成多檯開刀手術，「癌症病人不能等呀！」他說。不過，為了不讓家人太過擔心，他已經取消原本前往美國、以色列和日本的演講及研討會行程。往年，魏福全平均一年得出國工作八到九次。

外科醫生是非常耗費體力和精神的工作，但魏福全說自己其實沒有運動習慣，「我太太常常抱怨我不照顧自己身體，但我至少沒有不良嗜好，而且最近幾年都有睡滿六個小時，且也會到我家附近的碧湖公園走走路，算是有改進了。」

一路走來，魏教授在學術上累積非凡成就，其聲譽在該領域早已領先世界，並在國際上受到高度尊崇。他善用研究資源並將成果充分應用於臨床，造就當今癌症及外傷治療的新進展，落實了轉譯研究的精神；他創新的學術理論與手術方法不僅獲臺灣醫界採用，更是普及全球。

他訓練了如此多的國內外學生，在世界重建外科界產生龐大的影響，他的貢獻成功挽救無數的生命與健康，更維護了他們生命的尊嚴。綜觀魏福全的貢獻，他不僅成就了自己，也成就了別人；他改變了許多人的生命，也改變了這個世界。

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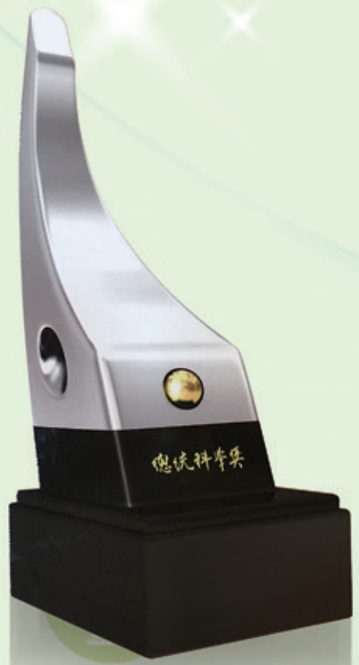
結語

由眾多傑出的候選人中，遴選出我國最優秀的科學研究學者，今年膺選的 3 位總統科學獎得獎人數理科學組李遠鵬院士、生命科學組陳垣崇院士及應用科學組魏福全院士，都是學有專精、成就非凡，且在國際科學界備受肯定的傑出學者。

多年來，他們對研究工作長期的專注與堅持，對科學研究的無盡付出與無私奉獻，讓臺灣在國際科學研究上能與先進國家齊驅並進、同步發展，不僅對臺灣及國人同胞有著莫大的助益，對於全人類的福祉更有著深遠的影響。

將來，還需要我們持續耕耘這一方科學園地，共同探求科學的極致光華，在國際科學上，展開更燦爛輝煌的未來。



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（任期 2018 ～ 2019）

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執行秘書	鄒幼涵	科技部常務次長

PREFACE

Established in 2001 and presented every two years, this is the 10th Presidential Science Prize. This prize symbolizes in the highest academic honor to pay respect to the most outstanding scientists in the Republic of China (ROC).

To promote Taiwan's position in the international science community, the Office of the President has established the Presidential Science Prize to recognize innovative researchers who have made monumental contributions to international research in the fields of Mathematics and Physical Sciences, Life Sciences, Social Sciences, Applied Sciences, especially those scholars whose works have had major impact on the development and applications of these fields in Taiwan.

To implement the selection and award of this prize, the President of Academia Sinica has convened a steering committee of fifteen distinguished scientists and related cabinet ministers. Nominees for the Presidential Science Prize are only taken into consideration when

(1) they are nominated by academicians of Academia Sinica and/or Presidential Science Prize awardees;

(2) they are nominated by academic and research institutions and associations and leaders of the community invited by the Presidential Science Prize Steering Committee.

After nomination, four selection committees in the above-mentioned fields perform nominee screening tasks. This year, through a careful nomination and selection process, the three awardees of this prestigious honor have been chosen as: Mathematics and Physical Sciences Category-Dr. Yuan-Pern Lee, Life Sciences Category-Dr. Yuan-Tsong Chen, Applied Sciences Category-Dr. Fu-Chan Wei.

Conferred by the head of state, the Presidential Science Prize gives recognition to those scientists for their long-term efforts at conducting scientific research and cultivating young researchers. This prize also aims to pay respect to outstanding scholars who have made top-notch academic achievements and to have scientific R&D fully benefit people's livelihood.

Mathematics and Physical Sciences Category
Academician Yuan-Pern Lee

Life Sciences Category
Academician Yuan-Tsong Chen

Applied Sciences Category
Academician Fu-Chan Wei

A Track Record of Achievements

Mathematics and Physical Science Category—

Yuan-Pern Lee

A Passion for Exploring the Foundation of Nature

Developed World-class Research in Taiwan

Professor Yuan-Pern Lee was born in Hsinchu in 1952. After graduating from the Department of Chemistry in National Taiwan University and serving in the military for two years, he went to the University of California in Berkeley, USA to pursue his Ph.D. Under the guidance of Professor George C. Pimentel, a well-recognized leader in chemical research, Professor Lee began his long journey of research in the field of free radicals.

After completing his Ph.D. and post-doctoral research for two years, Professor Lee returned to Taiwan in 1981 to serve as an associate professor in the Department of Chemistry at National Tsing Hua University. In Taiwan, few persons were then conducting contemporary fundamental experiments related to physical chemistry; the environment was not accommodating, but Professor Lee played a key role along the way, laying a strong foundation for contemporary fundamental science education and research in Taiwan -- he made a far-reaching impact.

Professor Lee's contributions to education include creating a modern course of physical chemistry in Tsing Hua University. He was the first to introduce chemical dynamics, laser chemistry, physical chemistry research techniques and laser chemistry experiments, and to introduce high-resolution Fourier-transform infrared spectroscopy (FTIR) in Taiwan. He also trained many physical chemists in Taiwan who proceeded to make outstanding achievements and to form the backbone of industry and academe in this field.

Professor Lee has also made an outstanding performance and contribution in administrative work. During his tenure as the Director of the Instrumentation Center at Tsing Hua University from 1991 to 2003, Professor Lee expanded the number of instruments from 12 to 28 and added many of the most advanced instruments in the fields of chemistry, biology, and material analysis so as to provide great resources and the best instruments for the nation's scientists to conduct research. These efforts were critical in improving Taiwan's research environment.

After transferring to National Chiao Tung University in 2004, Professor Lee served as Dean of the College of Science from 2005-2008, and greatly improved the quality of research and internationalization. His efforts included striving for the funding, planning and construction of the *Fundamental Science Education and Research Building*, assistance in the establishment of OCW (OpenCourseWare), establishing a *Bachelor of Science in Interdisciplinary Science*, recruiting outstanding college students to conduct cross-disciplinary science training, and offering opportunities for foreign exchange study to these students.

Professor Lee served also as Director of *Center for Interdisciplinary Science* (CIS) funded by the *Aiming for the Top University Program* of the Ministry of Education from 2006 to 2017. He organized several inter-disciplinary research teams dedicated to renewable energy, bio-sensing, and emergent materials or devices that are vital to the country's economy: the results have been outstanding.

He has recruited many foreign professors and promoted international exchanges and cooperation in his efforts to facilitate the internationalization of National Chiao Tung University. These professors not only brought unique technology and research topics of the world to Taiwan but also assisted scientists and research institutions in Taiwan, Japan, and other countries to establish extensive and profound exchanges and partnerships, so as to enhance Taiwan's international academic status and internationalization.

In academic research, since returning to Taiwan Professor Lee has made important contributions in the field of free-radical spectroscopy, kinetics and dynamics. Over the years, Professor Lee has identified over 100 new free radicals or new spectra that are important in atmospheric chemistry, combustion chemistry or astronomical chemistry; he consequently became highly recognized internationally.

He is the leader in *p*-H_2 matrix isolation and step-scan FTIR absorption techniques and was elected a fellow of American Physical Society (1999), an Academician of Academia Sinica (2008), and a fellow of the Third World Academy of Science (TWAS) (2011). In recent years he has received numerous awards, including the Honda-Fujishima Award of Japan Photochemistry Society in 2016, the Humboldt Research Award in 2017, and the George C. Pimentel Prize, the highest honor in matrix isolation, in 2018.

He is the first in the world to develop step-scan FTIR gaseous absorption spectroscopy and a pioneer in the study of transient infrared absorption of gaseous free radicals, using this technique to detect the spectra of many radicals for the first time. A key contribution was his first recording of the infrared spectrum of the Criegee intermediate and the discovery of its rapid self-reaction, which has driven the research in this field worldwide. The Criegee intermediate is an important atmospheric chemical reaction intermediate proposed over 60 years ago, and is closely related to the disappearance of ozone in the atmosphere and the generation of hydroxyl radicals and aerosols. The discovery by Professor Lee has established important milestones for related research.

In terms of *para*-hydrogen matrix isolation, he applied solid *para*-hydrogen (*p*-H_2) as a novel matrix host to develop many new applications, making him a leader in this field. He recently applied electron guns to produce protonated polycyclic aromatic hydrocarbons (PAH) to examine their infrared spectra and to speculate on the source of some unidentified infrared (UIR) emission bands in outer space. He developed also a highly efficient method for the reactions of atomic hydrogen to study the hydrogenation of important molecules in outer space and to explain some mysteries of astronomical observations over the years. These efforts have made a significant contribution to interstellar chemistry. All these results arose from Professor Lee's unrelenting efforts over the years, which not only made outstanding contributions to Taiwan's scientific research and education but also proved that Taiwan is capable of creating world-class research and should be proud of its advancements.

Commitment to Fundamental Research, World Leader in Free Radical Spectroscopy

Seeking the Truth and Devoting to Science Education

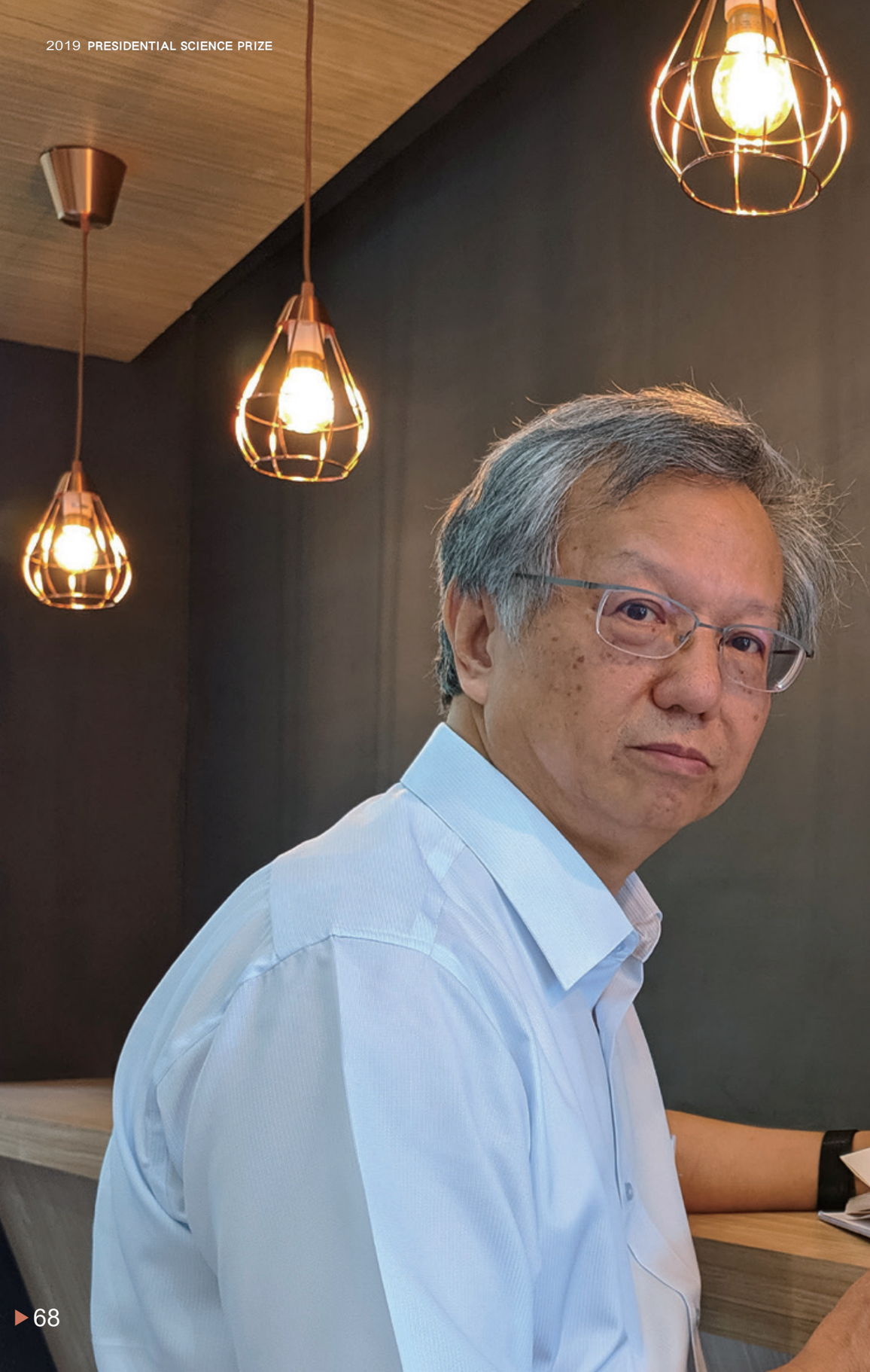
Professor Yuan-Pern Lee has always performed well in mathematics and science since childhood and loves critical thinking and fixing things with his hands. After rigorous training and decades of dedication in research, he has achieved a position of international leadership in the field of free-radical spectroscopy. Notably, Professor Lee's research work in the past 40 years was all completed in Taiwan. As he said, "Although Taiwan does not have the most sophisticated and expensive instruments, it still has the strength to provide world-class research opportunities."

At the same time, he has taught at National Tsing Hua University (NTHU) and National Chiao Tung University (NCTU) for many years, and laid a solid foundation for modern physical-chemistry education and fundamental research. In addition to educating many physical chemists in Taiwan, Professor Lee has done executive work and contributed to the improvement of the research quality and international academic status of the College of Science, NCTU. Although he has won many awards and is highly respected, Professor Lee maintains a low profile and humbly believes that his work is recognized while he was just doing what he loves to do, which showcases the modesty of a true gentleman.

Growing up in a Big Family, Influence of His Third Sister

Professor Lee was born in Hsinchu in 1952. He has eight siblings in his family and is the youngest. As a boy, he recalls his childhood life as ordinary and simple. Looking back, his father Tze-Fan Lee was a well-known watercolor artist and his eldest brother Yuan-Chuan Lee and second brother Yuan-Tseh Lee are both famous international scientists. Yuan-Pern Lee set a record of having "three masters in one family" together with his two brothers as an Academician of the Academia Sinica.

"My eldest brother is 20 years older and my next eldest brother is 16 years older than me. They traveled abroad for further study when I was in the first and sixth grade, respectively. They were also studying at National Taiwan University (NTU) and spent little time at home when I was young. I had little memory of them." Professor Lee recalls, "My best friend and also the person who influenced me the most is my elder sister Chi Mei, who is three years older than me." Chi Mei Lee, a graduate of Department of Agricultural Chemistry of NTU and Ph. D. of Institute of Microbiology, University of Göttingen, was vice-president of National Chung Hsing University and a professor of its Department of Environmental Engineering.



“My father was 45 years of age when I was born. My elder brothers and I have different memories of our father as if he were a different person,” Yuan-Pern Lee says with a smile, “My brothers were born during the Japanese occupation era and my father was very strict in discipline. My eldest brother was once punished by being confined in a large wooden bathtub without any light. My third sister and I were never punished. Mother said it was because we behaved very well, but I think it was because of the change in times and because my parents had become older!”

In Lee’s memory, his parents did not require him to have an outstanding school performance or have much expectation for him. He even had the freedom to make his own choices when selecting his department and college, and his parents interfered not at all. As he listed only 20 departments in his application after entrance examination, his mother’s only concern was, “Is that number sufficient?”

His third sister Chi Mei played an important role in Lee’s study. “I remember that, when I was in junior high school, it was only when school began that I discovered that our English teacher failed to report for duty. Only after a few weeks did the principal serve as the substitute, so my English proficiency was poor at the time. When my sister learned about this condition, she was anxious. She kept encouraging me and helped me to maintain progress. If it were not for her help, the poor English proficiency would have had a tremendous impact on my future research and studies.”

In addition, à propos of his talented third sister, she would encourage him to read her textbook when he was in high school and share her experience with him. This activity inspired his interest in reading, which developed into a habit. He had already read several books before the school dispensed them.

“My third sister took care of me in many aspects. The reason that I played the flute was that she was playing the clarinet; she encouraged me to learn together”, Yuan-Pern Lee admitted gratefully. During high school, he and his cousins also presented concerts together; it was a joyful time.

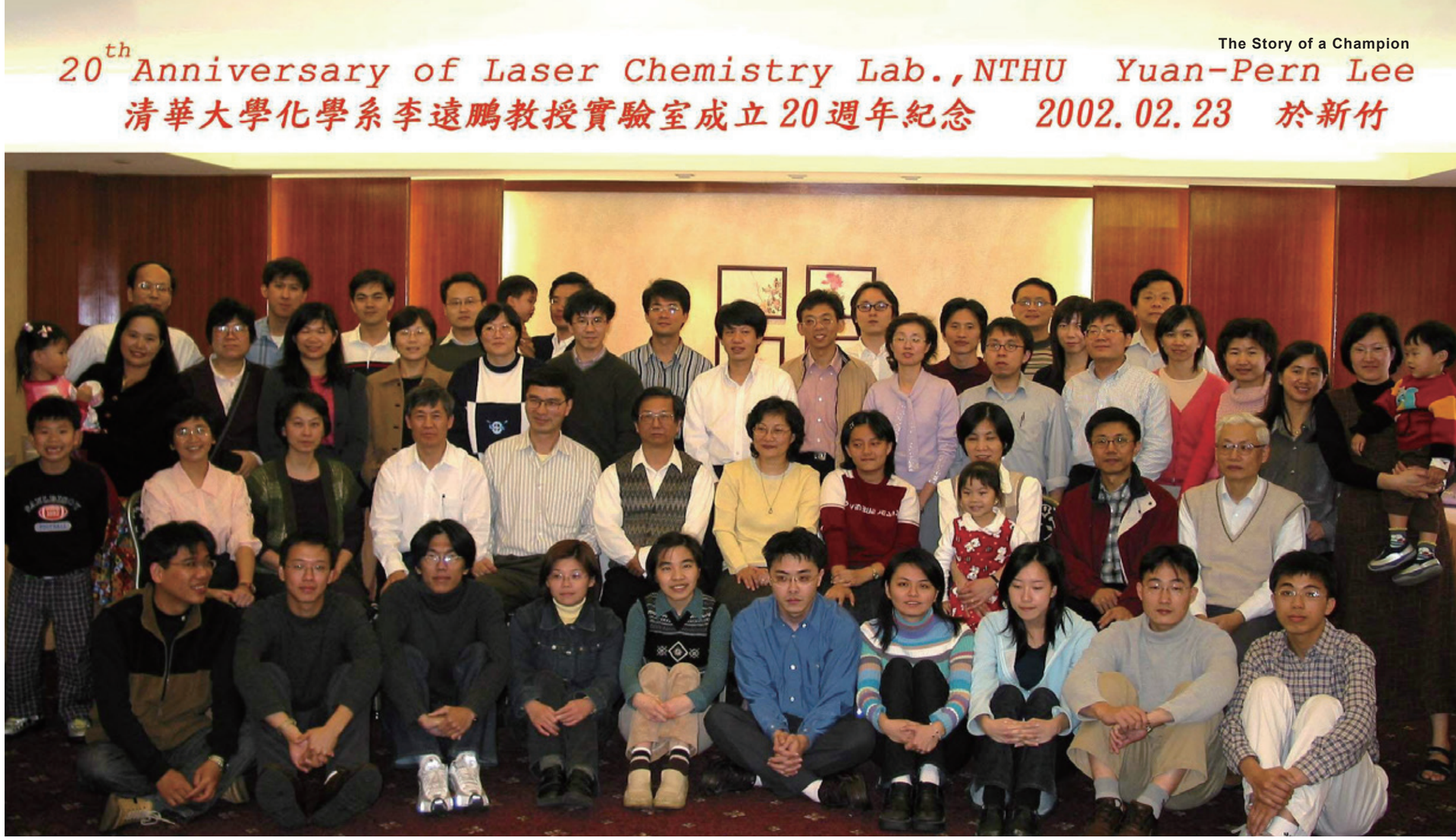
Smooth Learning, and Showing Great Potential Since Youth

Speaking of his learning process, Yuan-Pern Lee said that there was a time when he was naughty and playful, and failed to submit his homework. However, he became wiser after the sixth grade, and his grades excelled. His grades on the university entrance examination allowed him to enter any desired department; his eventual choice was the chemistry department of NTU.

“At that time, it was generally believed that studying science had better chance for higher education. Although my top performance was in mathematics (among physics, chemistry, and mathematics), the mindset was that there was little future in this field. Although I much enjoyed physics, I did not excel in it. After these considerations, chemistry was my final choice.”

“I was well aware that I enjoyed reading and studying; so it was natural for me to select the path of research. I remember that I enjoyed repairing things since I was just a child. When a clock was broken, I would take it apart and fortunately fix it without even knowing how. My aunt would sometimes call me to repair some of her broken things!”

Although his elite brothers and sisters also studied chemistry, “I do not think that that condition had an impact on me; it was my own choice. I guess that I might have thought that this field must be pretty good as they decided to develop in this direction!”, he said with a smile. As intelligent as he is, he admits that learning was not difficult for him; it takes work, but not much hard effort. During college, he even joined the NTU symphony orchestra playing the flute and took on the position as the head of the team. Even so, he still graduated with high marks.



Berkeley – an Entire New Learning Experience

After graduating from the National Taiwan University, Yuan-Pern Lee went to University of California in Berkeley, USA to pursue his doctoral studies and began an entire new learning experience. “Although I have read many books, from an experimental perspective, I actually knew nothing and I had no experience at all. I had not seen even the simplest vacuum system, did not know how to blow glass to make experimental devices, and did not know how to write the most basic experimental records.”

“When I entered the laboratory, I knew that I had so much to learn and was way behind everybody else. The only thought in my mind was that I had to catch up with my classmates without delay,” he said. “This situation was a great shock for me. I was working so much harder than I had at National Taiwan University because there were so many things to learn. The only time spent outside the laboratory was when I was eating or sleeping. I rejected my friends’ weekend invitations, and completely buried myself in my work. My friend finally could not help but ask, 'Who is checking on you?'”

Under Yuan-Pern Lee’s self-demand and hard work, he rapidly progressed -- his supervising professor even wanted to let him graduate at the end of his third year. “My professor was to take a position at the National Science Council in Washington, D. C., and would be absent during my fourth year. As my research was almost completed, he said that he would let me graduate if I wished to do so.”

“At that time, the average duration of acquisition of a Ph. D. from Berkeley’s chemistry department was 4.9 years. If I could graduate within three years, it would be a great story to brag to my future children. I really hesitated, but I thought that, as my experiments had just begun to proceed smoothly and as there were still many studies that I wanted to undertake, I thought that there was no need for haste and I decided to stay for another year.”

Afterwards this decision proved to be correct. During this year, because of the supervisor’s absence, the students’ aptitude levels could immediately be differentiated. Yuan-Pern Lee worked hard and made many achievements because of his high independence. He consulted with the professor regularly, which allowed his professor to know better how well Lee was progressing. His professor even suggested that he no longer needed to devote a period to post-doctoral research, but should begin teaching as a professor.

However, as good a student as he was, he still believed that he had to continue his studies in different sub-areas and to expand his horizons. He subsequently entered the Environmental Research Laboratory of the National Oceanic and Atmospheric Administration in Boulder, Colorado as a researcher and conducted two years of postdoctoral research to study atmospheric chemistry and reaction kinetics.

Learning from a Great Master

Lee’s supervisor Professor George C. Pimentel was the inventor of chemical lasers and a pioneer in free-radical research applying matrix isolation, and so held a much respected academic status. Yuan-Pern Lee worked in the free-radical research field for many years under this professor.

Recalling his relation with this professor, in addition to providing advices to research work, Yuan-Pern Lee said, “My professor had a greater influence in terms of his mindset, especially his attitude towards science and his perspectives on his students.”

“My professor was always willing to encourage his students. I knew nothing the first time that I entered the laboratory. Other students could not help but complain about me and my professor heard about it. After my first presentation during the group meeting, however, my professor praised me in front of everyone, saying that I was able to anticipate questions and made preparations. In addition to giving me confidence, I thought that he was saying it to let my classmates know! Even when facing students who were not dedicated, the professor always patiently guided them and tried to inspire interest.”

“In addition, experimental research was the mainstream activity; theoretical calculations were just becoming initiated at that time. Many teachers were scornful of calculations and thought it impossible to be more accurate than experiment, but I wanted to give it a try to see whether I could prove the experimental results via different

perspectives. Although my professor didn't think it would help much, he still agreed that I should follow another professor to study quantum-chemical computation."

Later, Yuan-Pern Lee spent many busy days doing both experiments and calculations. He would be busy with experiments during the day and go to the computer center to perform calculations at night, working all day. Fortunately, his hard work paid off. The calculations achieved satisfactory results and changed the professor's views on theoretical calculations. "It is rare for such an eminent professor to have an open mindset. This also affected my future teaching and research, he said.

Returning to Taiwan to Lay the Foundation for Science and Education

After completing his post-doctoral research, it would have been easy for Yuan-Pern Lee to stay in the United States and to teach and to do research if he wanted, as he performed well, but, without making any job application, he decided to return to Taiwan to teach.

"I had several considerations when I returned to Taiwan. First, my parents were old and my father even had a stroke previously, and most of their children were not around. I felt that I had to return home to help them. In addition, the National Science Council had increased research funding for the new professors at that time. It was hence likely that I could continue to do research in school. Otherwise, I would inevitably have felt disconsolate if I could only teach. Moreover, when I was in college, I felt that Taiwan's faculties were not good enough. Instead of criticizing, we should return to Taiwan to change the environment after we complete our studies. More importantly, my wife also supported me, so I could make this decision without any hurdle."

Yuan-Pern Lee thus returned to Taiwan in 1981 as an associate professor of Department of Chemistry, NTHU. He was just 29 years old. Being young and impulsive, he felt extremely frustrated when his application for sufficient funds from National Science Council to purchase experimental equipment was unsatisfactory. "Looking back on my research history, this was probably the most frustrating period. I was full of enthusiasm, but could find no support. I almost wanted to return to USA."

Fortunately, with the assistance of department Chair Chao-Ting Chang and Professor Chao-Shiuan Liu of the Department of Chemistry, Yuan-Pern Lee had the opportunity to receive funding support from the department and to participate in other research projects; his research work slowly resumed productive activity. "Only in 1985, four years after returning, was I able to publish my first paper; much time was stalled."

After overcoming an initially difficult situation, Yuan-Pern Lee successfully started teaching and research in NTHU. During this period, he was awarded the NTHU Outstanding Teacher prize twice on demonstrating his enthusiasm and professionalism. He served also as the Director of the Instrument Center from 1991 to 2003. Through active fund-raising and excellent management, NTHU Instrument Center became the best in the country in terms of service and equipment, so providing assistance for many domestic scientists in research work.

Admirable Administrations after Transfer to National Chiao Tung University

In 2004, Yuan-Pern Lee decided to relocate to National Chiao Tung University at the invitation of Academician M. C. Lin (Director of Center for Molecular Science, NCTU) and Chun-Yen Chang (President of NCTU), and assumed the position Dean of Science in 2005. Lee indicated, "When I was in NTHU Department of Chemistry, I had several opportunities to serve as the department chair, but I declined because I sought to concentrate on research, I enjoyed doing meaningful things, and did not like administrative work. At that stage, not only had I transferred to a department with a less-than-ideal environment, but also I became a dean. It was jaw-dropping for many NTHU colleagues!"

At that time, NCTU was competing for the "Achieving Top Universities" program of Ministry of Education for a five-year period. The staff thought that they would need Lee to lead and to promote the research abilities of NCTU College of Science. Although this idea was not from his original plan, Lee recognized a great opportunity for the college and decided to take the responsibility and to commit to this "meaningful" administrative work. Although he served only one term, during those three years as Dean of Science, he actively promoted various projects and was praised for having completed ten years worth of important work.

His achievements included the establishment of *Center for Interdisciplinary Science* to enhance research capabilities, creating normalized organizational operations, strived for funding to the construction of a *Fundamental Science Education and Research Building*, establishing a *Bachelor of Science in Interdisciplinary Science* to recruit excellent students to perform interdisciplinary science training, and promoting OCW (OpenCourseWare) network teaching. In addition, he vigorously promoted the internationalization of NCTU College of Science, recruited several top foreign professors, and actively promoted international exchange and cooperation to enhance Taiwan's international academic status and internationalization.

These measures laid a solid foundation for NCTU College of Science and it began to catch up. In particular, the total number and quality of papers published from NCTU Department of Applied Chemistry has grown by leaps and bounds. After a few years, its performance is no longer less impressive than that of NTHU or NTU. “Reflecting now, I feel that I made the right decision; under NCTU’s open and flexible school spirit as well as the trust and support by the principals, I had the opportunity to make a contribution.”

Despite his outstanding performance, Lee retreated after one term, and resumed to focus on his favorite research work, so to serve as the project leader of the research center. “I am not an ambitious person, who seeks to achieve something great. I just follow the situation, take responsibility when I must and do it right -- that is all”, he said modestly.

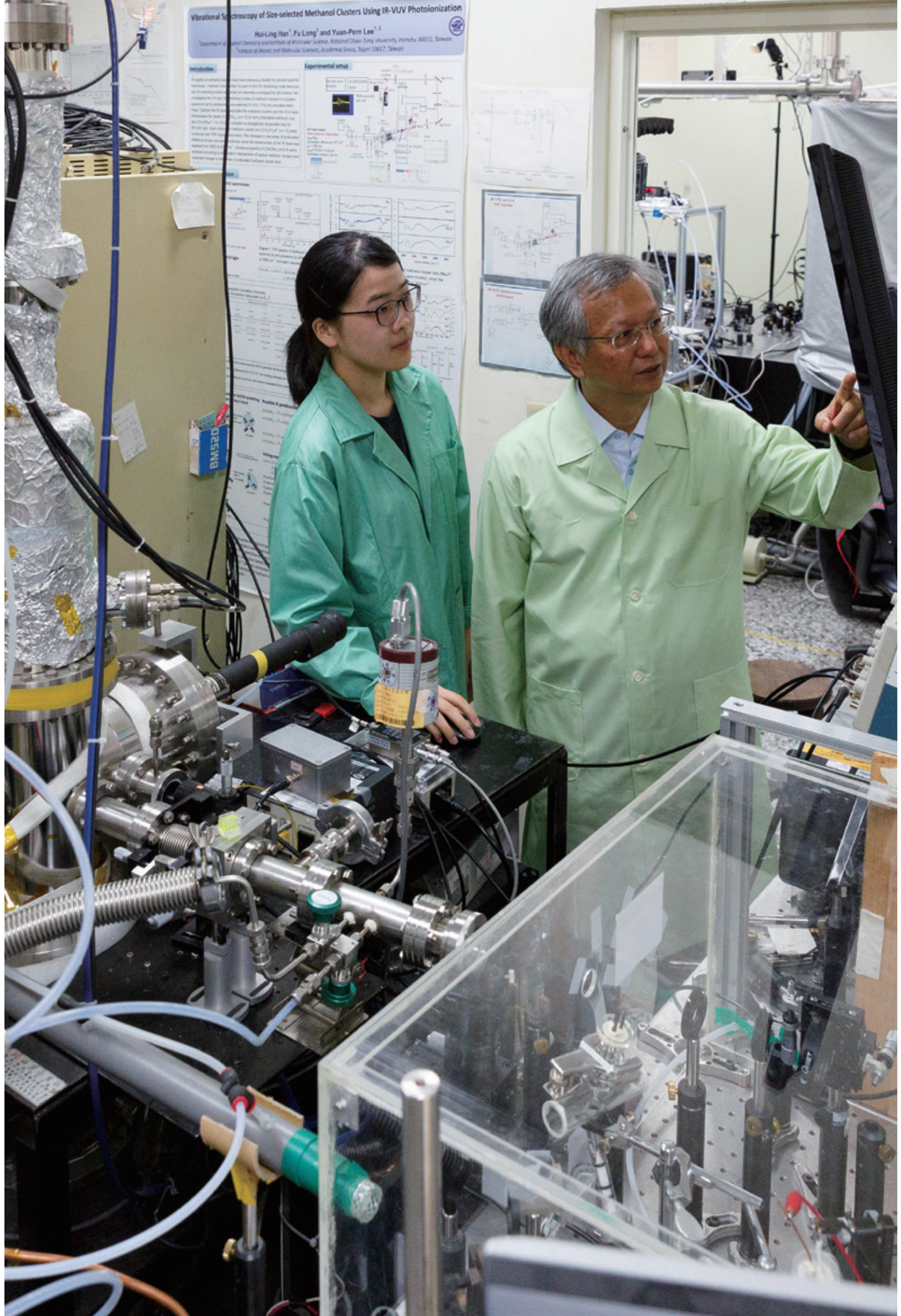
“I think that I am one of few who say *no* to an opportunity because I assess my time allocation. I never over-commit or accept too many positions so to become overwhelmed. As long as I make a commitment, I complete the task with full dedication.”

He describes himself as “my brain can function like a switch: it can be efficiently switched between different work, and perfectly manage the time and master the schedule with precision.” Therefore, despite the busy administrative work, the number of papers published did not decrease at all, and everything was implemented according to plan when Yuan-Pern Lee was dean. “I can proudly say that I had never been overwhelmed to the point at which I had to deliver the work after a deadline!”

Persistent and Unyielding, his Free-radical Research is World Leading

Yuan-Pern Lee has dedicated himself to free-radical research for many years. He explains, “A free radical is a molecule with an unpaired electron and in an unstable state. Because of its great reactivity, the free radical reacts with other molecules everywhere, just like the naughtiest student in a class who frolics, and plays an important role in atmospheric chemistry and combustion chemistry.”

Although this basic research aims to explore the essence of nature, it is closely related to our lives.



“For example, the well-known ozone depletion is caused by the fact that the CFCs used by human beings are photolyzed in the atmosphere to produce chlorine atoms and chlorine-containing free radicals, which then react with and destroy ozone. Understanding the root causes of this problem, we can propose a solution. The ozone depletion is proved to be slowly recovering after the ban of CFCs.”

Particularly in recent years, the importance of atmospheric chemistry has increased because of serious air pollution problems associated with aerosols or particulate matter in addition to the ozone layer issues. Free-radical research is also related to astronomical chemistry. Because there are many and varied molecular components in the universe, scientists must infer the composition via the measured spectra. For this purpose, comparison with the spectra of related molecules in the laboratory is necessary to identify the existence of specific molecules and to understand how the various molecules are formed. The origin of life is also related to how molecules in outer space gradually form molecules such as amino acids. Free radicals play an important role also in these reactions.

As the lifetime of a free radical is short, conventional methods of detection fail because their speed is too slow. Therefore, it is necessary to find a method to decrease the activity of free radicals or to use special equipment to grasp the moment when it temporarily exists, and Lee owns some global-leading techniques in both fields.

“Matrix isolation is a technique in which free radicals are isolated at cryogenic temperature for research. Inert gases were used for isolation during the early days, just like putting good students around a naughty student so that the naughty student has no one to distract and can no longer frolic. In recent years, we have used a *para*-hydrogen (*p*-H_2) quantum solid as the new matrix host, which has many advantages that inert gases do not have. We have also developed new techniques for protonation and hydrogen reaction for astronomical chemistry, and achieved great results.” For this achievement, Yuan-Pern Lee received the George C. Pimentel Prize (named after his advisor) in 2018, which is the highest honor for research in matrix isolation.

To capture free radicals in another manner, Lee leads the world in the first development of the gaseous research technique involving a step-scan Fourier-transform infrared absorption spectrometer. The Criegee intermediate was first detected with this technique, proving that this extremely important intermediate in atmospheric chemistry proposed in 1949 but never previously detected is indeed present. This research paper was published in the world's foremost *Science* journal in 2013 and attracted much attention. This achievement provides a direct method to monitor and to study its related chemical reactions. It not only drives the research trend in this field, but also sets an important milestone for research in atmospheric chemistry.

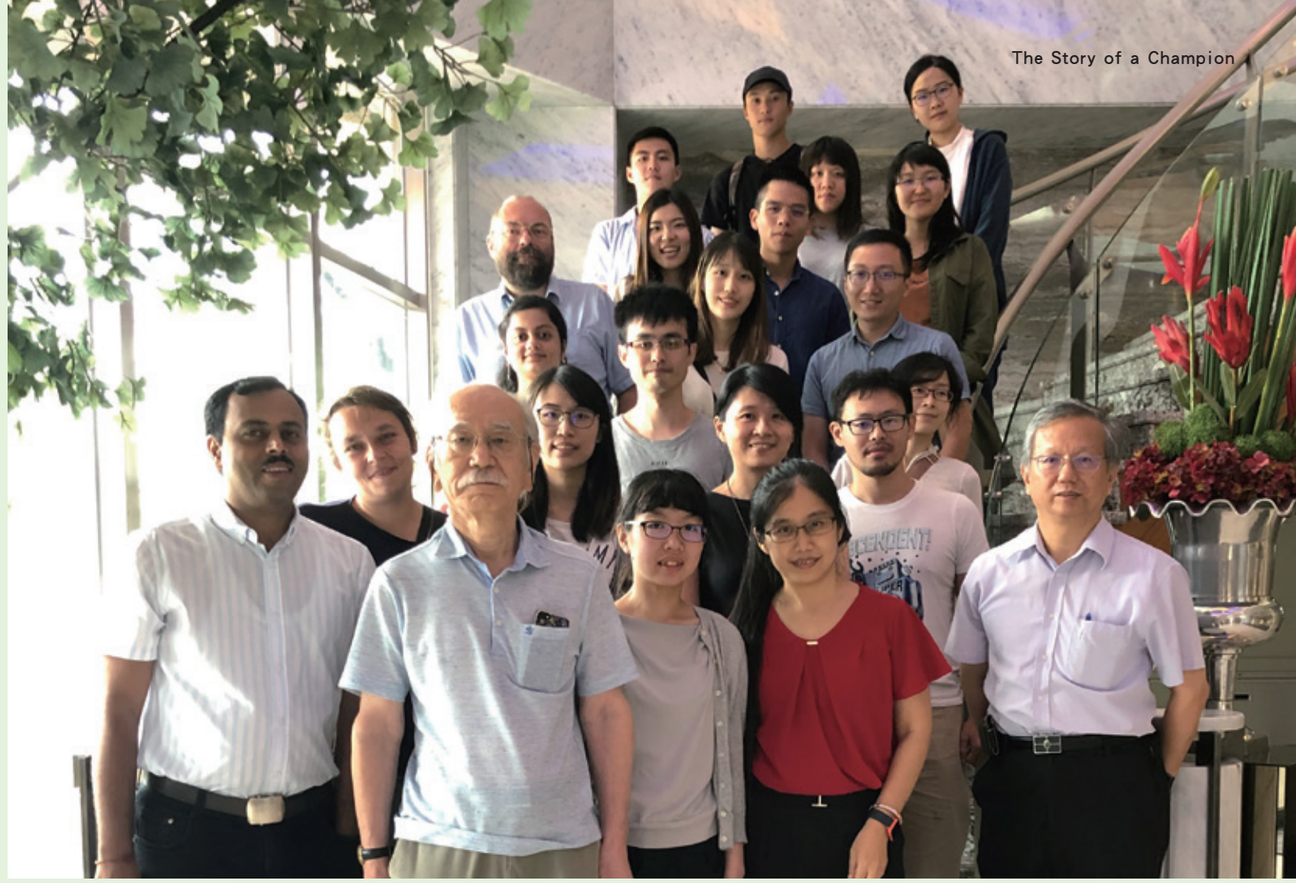
Winning Countless Awards

Since returning to Taiwan in 1981, Yuan-Pern Lee has received countless academic honors including the National Science Council Outstanding Research Award, the Chemical Society Academic Achievement Award, and Ministry of Education National Chair Professor. He has also been elected an American Physical Society fellow and Academia Sinica Academician, and won the Presidential Science Prize. In terms of international awards, the 2017 Humboldt Research Award and the 2018 George C. Pimentel Prize are prestigious honors.

In this regard, he said that hard work and persistence are required relentlessly; it takes change and innovation, continuous improvement, and an introduction of new research methods to solve problems before achieving success. "This situation also means that, even without the most cutting-edge or expensive instruments, we have still an opportunity to make research that others cannot do. There is no need to underestimate ourselves. Meanwhile, this situation also reflects the excellent research environment at National Chiao Tung University such that it can undertake world-class research. These research results have truly gained international recognition such that I have been invited to deliver speeches at important conferences worldwide. Of course, these awards are not issued because I myself was amazing -- they are attributable to the support of the government, schools, my students, colleagues, and my wife over the years."

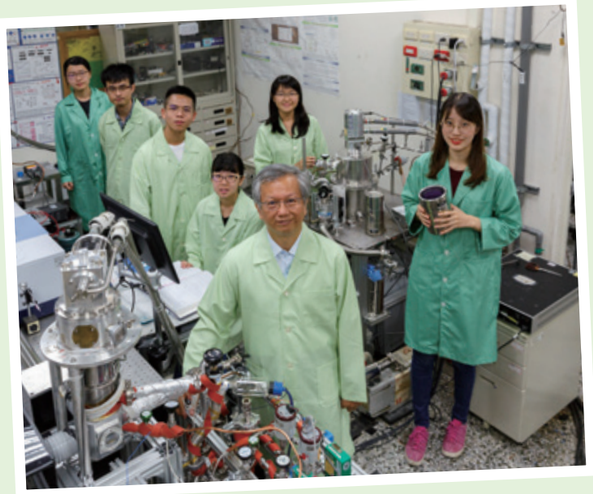
"Although many scientists now devote their attention to popular fields such as nanotechnology and solar energy, atmospheric chemistry and astronomical chemistry continue to be important. Scientific research should not be assessed on popularity. The key point is whether you can continue to improve and strive for the best."

For Yuan-Pern Lee, the sense of accomplishment and joy brought by the research work is the greatest reward. Other factors are just by-products, not deliberately acquired. Many awards come naturally. "For example, I won the Humboldt Research Award from the German Humboldt Foundation in 2017, because I met a professor in a conference and had a happy conversation discussing the content of our papers, so I was recommended for the award." By upholding the scientific spirit of seeking truth and facts, he has



been persistent in pursuing progress for 40 years and cultivating world-class research energy in the domestic environment.

Even now, Yuan-Pern Lee still work until after midnight at least two days a week. He even takes time from his wife to go to his office for work on Saturdays. He laughed, “I often joked with my colleagues that, whenever I feel that I am going to become sick, I will need no medicine if I just go to the laboratory. Because I love research work, the work distraction would eliminate the physical discomfort!” “I want to thank my wife in particular. My work has been my first priority for many years. My wife not only gives me full support, but also is independent and capable of taking care of the children and handling the housework so that I have no worries. I also learned much from her about the principle of treating others.” Mrs. Lee graduated also from National Taiwan University. After obtaining a degree in pathobiology at University of Washington in Seattle, she returned to Taiwan to teach in the Department of Medical Laboratory of Yuanpei University of Medical Technology. She retired several years ago.



Concern about a Talent Gap

Although Yuan-Pern Lee has great achievements in the free-radical field, he is now concerned about finding successors to transmit the knowledge and to maintain the leading position in the world. “I remember that, when I was in National Tsing Hua University, my classes were packed and even the aisles were filled with people because the students knew that they could acquire knowledge in my class. I also taught everything that I knew, collecting the essence from each book, preparing thick handouts, and seeking to pass the best and most complete content to the students.”

It is a joy to educate the talents of the world. Yuan-Pern Lee admitted that he makes high demands of students and values training in logical thinking. He said, with a sense of pleasure, “Many students returned after taking a job and asserted that, although they had been criticized by me in school, they became praised by their supervisor after employment.” “There have been many outstanding students over the years now working in National Synchrotron Radiation Research Center, Industrial Technology Research Institute, Science Park, or teaching at National Tsing Hua University, National Chiao Tung University, National Sun Yat-sen University, and other universities. They all have great performances.”

On the topic of the declining quality of the students in recent years, he said, “Under the influence of the Internet and mobile phones, young people today may have many advantages, but most of them do not think any more, have no deep thought, read no book, and lose interest in pursuing truth. It is indeed a dire problem.”

“In the past, the number of students in my class should often be limited because of excess enrollment, but now fewer and decreasing students are taking my class.” Speaking on this topic, he could not help but sigh, “I do not believe that my teaching is regressing. Nowadays, students do not study and naturally cannot judge the quality of their teachers. They just want to get passed easily. In the past, I tried to find a way to challeng the students in examinations, but there were always people who would beat the challenge. Now, even with a lowered bar through simpler questions from previous examinations, most students still find it difficult. If the situation does not improve and if a high-level talent gap is formed, no effective professor can be found in the future, especially in the field of fundamental science.”

For Yuan-Pern Lee, the biggest issue now is that no one wants to study for a doctoral degree anymore. At one time, the doctoral students under his supervision numbered more than a dozen. The present lone doctoral student of Lee was admitted after six or seven years of vacancy. In contrast, many foreign students from the USA, Germany, and Hungary are attracted by Lee’s leading technology and have come to learn and to intern for short terms, whereas few domestic students have joined his laboratory to learn about leading research fields.

“The laboratory work has become difficult because of few students. Without doctoral students, the knowledge cannot be transmitted. To maintain a world-leading level, compromise is unacceptable. So I must spend more time in the laboratory.”

“The boilerplate education in Taiwan has made it impossible for the students to have the chance to discover their interests and abilities, and it is commonly the society’s secular belief that salary is the most important aspect. This idea must be changed. It is a pity that I once had a few good students who preferred to work in Hsinchu Science Park for increased salary or were unwilling to continue for doctoral study because of their parents’ objections.”

Yuan-Pern Lee hopes that everybody can work together to solve this serious problem. In particular, the primary and secondary education must be improved so that the students have greater opportunity to think and to stimulate enthusiasm to seek truth and fact. In the universities, it is through the establishment of a system that allows experience to be transferred and techniques to remain intact. For example, Japan has a deputy system for university professors, and Europe has a similar system. A vacancy for a professor actually involves a team with technicians or associates so that a professor is no longer fighting and struggling alone.

Let the Success Come Naturally

“For me, salary should not be the key consideration for choosing a career as long as I do not have to worry about my livelihood. Although many people are rich, their life satisfaction is not always abundant. Such a life is not necessarily worth pursuing”, he said.

“Indeed, although the salary of many employed students much exceeds that of an average senior professor, the quality of life is not necessarily better. I often tell students that, if you are interested in research, it is really a worthy choice to become a professor. Not only is your time free, but the experimental equipment is funded by the state and you do not have to pay for it yourself. The sense of accomplishment from being able to enjoy working, to pursue truth, to solve problems, and to make progress every day is not something that money can measure.”

“I do not think that I am the kind of person who would take the rise or fall of the country as my own responsibility. I do not care about secular views, I scramble for nothing, and I have modest ambition. "If I had been really obsessed with undertaking the most cutting-edge research, I would not have returned to Taiwan, even though these feats were subsequently accomplished.”

Life is about feeling at ease under all circumstances, but doing things well with hands-on with others that demands the best at every phase of each task. This seemingly simple and ordinary life philosophy has extraordinary wisdom. The drop and trickle of efforts become a torrent, making Lee’s teaching and research career truly abundant, and the success comes naturally.

Yuan-Pern Lee has postponed his retirement and won a five-year *Summit Project* of Ministry of Science and Technology this year. Although he must retire from university at age 70, his research career can continue until age 73. He will continue to devote himself to his favorite research in hopes of finding successors smoothly so that the knowledge of free-radical research bred and expanded in the domestic environment can be perpetuated.

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10. "Hydrogen abstraction/addition tunneling reactions elucidate the interstellar H_2NCHO/HNCO ratio and H_2 formation", K. A. Haupa*, G. Tarczay*, and Y.-P. Lee*, J. Am. Chem. Soc. 141, 11614 (2019).

A Track Record of Achievements

Life Science Category—

Yuan-Tsong Chen

Translating Research into Clinical Practice: Discovering cures for rare diseases Preventing drug toxicity with a gene test

Joining Academia Sinica and turn Taiwan into a Genomics Medicine Research Powerhouse

Academician Yuan-Tsong (Y-T) Chen specializes in the research of Genomic Medicine and Translational Medicine. His research covers Glycogen storage diseases (including Pompe disease), adverse drug reactions (ADR), and the search of susceptibility genes for common diseases. His achievements include the development of drug for Pompe disease called Myozyme which received market approval worldwide. Chen also led the team that identified the susceptibility genes for certain adverse drug reactions, allowing ADR prevention via genetic screening before prescribing medication.

Academician Chen has successfully developed treatments for two types of genetic metabolic disorders, and such treatments have become the standard therapy. One of them is the cornstarch treatment for the low blood glucose-associated glycogen storage diseases. The other is the new drug “Myozyme”, developed as an enzyme replacement therapy to treat Pompe disease, which is a result of enzyme deficiency that cause severe weakness in muscles and cardiorespiratory failure in due course. In infants, most die before the age of 2. The invention of this new drug has saved numerous previously hopeless patients.

Academician Chen’s team has also identified a number of susceptibility genes that predispose patients to adverse drug reactions and makes it possible to pre-empt certain severely adverse reactions to drugs. Targeting the pharmacogenetic study of two severely adverse drug reactions -- Stevens-Johnson syndrome (SJS) and toxic epidermal necrolysis (TEN) – that can cause a fatality rate of up to 40%, Chen’s team has identified genetic makers for SJS/TEN induced by Carbamazepine, a drug used to treat epilepsy, and

by Allopurinol, a drug for gout, both of which can induce SJS/TEN. Regarding the dosage of the widely prescribed anticoagulant, Warfarin, Academician Chen's team has discovered that the VKORC 1 gene polymorphism plays a critical role and the team further took part in the International Warfarin Consortium to formulate a universal algorithm based on genetic and clinical data to better predict an optimum Warfarin dosage for each individual to avoid abnormal bleeding after taking the medication.

These pharmacogenetic research findings have prompted the world-wide FDA and the major medical associations to re-label these commonly prescribed drugs, Warfarin, Carbamazepine and Allopurinol, with genetic information, and advised doctors to conduct genetic screening before prescribing the medication; thus allowing prevention of adverse drug reactions. The use of these medications is thereby more safe and more personalized, led Taiwan into the era of Personalized Medicine and Precision Medicine.

In 2001, Academician Chen accepted the invitation and returned to Taiwan as Director for Academia Sinica's Institute of Biomedical Sciences (IBMS). Chen re-positioned the IBMS' research towards Genome and Translational Medicine and actively promoted domestic and international collaboration, brought together a strategic alliance between Academia Sinica and the international pharmaceutical Company, GlaxoSmithKline, and the US gene-chip company, Affymetrix, in order to conduct large-scale multinational, multicenter studies. Under Chen's leadership, there has been a notable quality enhancement in academic papers published by the Institute investigators, and it has since become a norm for the IBMS research findings to be published in top-notch international scientific journals. Since 2017, Academician Chen has been proactively assisting the IBMS conducting Precision Medicine research and brought Taiwan's already highly successful genomics medicine research into the Precision Medicine era.

Academician Chen has built infrastructures in Taiwan for large-scale genetics and genomics research and high-quality clinical investigations. He founded the Academic Contract Research Organization (Academic CRO) and established the Good Clinical Practice (GCP) guidelines to assist Taiwan's investigators conducting Translational Medicine research. Meanwhile, Chen has founded the National Genotyping Center (NGC) to provide high-quality and high-throughput genotyping services..Taiwan has since joined many international genomic medicine and biobank research consortia. With all his efforts, Taiwan has became one of the world's powerhouses in genomic medicine research.

Extended his immense interest in rare disease, Academician Chen, during his tenure as Chairman of Taiwan Foundation for Rare Disorders and President of Taiwan Human Genetics Society, established a rare disease research network and care mechanism for patients in Taiwan, which has became an international benchmark attracting many countries to come for a study visit. As a result when international pharmaceutical and biotech companies develop new drugs for rare diseases, they would vie to conduct clinical trials in Taiwan.

Academician Chen's many inventions and patents have been licensed to Taiwanese companies. The Pompe disease treatment patent was licensed to Taiwan's CSRC Group, which was later sub-licensed the patent to the US Genzyme Corp, which manufactured the drug Myozyme and received market approval world-wide. The patent for adverse drug reactions (ADR) risk assessment was licensed to PharmiGene, a Taiwan-based biotechnology company, which has successfully developed a quick screening kit, now used in clinic for ADR prevention. Chen also applied his rich biotechnology experience as scientific consultants for a number of Taiwanese biotechnology companies to nurture and help to promote Taiwan's biotechnology industry.

From 2010 to 2014, Academician Chen founded and led the "Academia Sinica Translational Medicine Research Program" to actively train young students and nourish physician-scientists in conducting quality translational research and clinical investigations. . Academician Chen has also assisted the planning of the "National Biotechnology Research Park" and provided Academia Sinica with advices on the Park's overall development.

A physician-scientist dares to be different

Discovering cure for rare diseases and save lives out of despair

Through persistence, Yuan-Tsong (Y-T) Chen eventually found cures for rare diseases which previously had no treatment. To contribute to medical research in his home country, Chen returned from the US to build Taiwan into an important medical genetics/genomics research center. Despite being retired, he is still involved in the development of Taiwan's Precision Medicine and Preventive Medicine Program.

Chen specializes in Genomic Medicine and Translational Medicine. His research covers glycogen storage diseases (including Pompe disease), adverse drug reactions (ADR), and the search of susceptibility genes for common diseases. Chen's research achievements include the development of a drug for Pompe disease called Myozyme which received market approval worldwide. Chen also led the team that identified the susceptibility genes for certain adverse drug reactions, allowing genetic screening before prescribing some commonly used medications.

Chen led the Institute of Biomedical Sciences (IBMS) in Academia Sinica and developed it into a renowned research center in Asia. He re-positioned its direction towards Genomic Medicine and Translational Medicine, while promoting domestic and international collaboration. He actively assisted the IBMS Precision Medicine Program and propelled genomic medicine into the Precision Medicine era.

Born into a family of doctors, Chen carves out his own path

Chen was born into a family of doctors. His father, Chen Chiung-Lin, was a well-known pediatrician. His parents expected him to become a doctor. Chen was admitted into National Taiwan University (NTU)'s College of Medicine for top scores in academic performance and did not have to sit for the mandatory university entrance exam. Until his last day in university, he was compliant with his parents' expectations. Yet once he obtained his qualifications as a physician, he decided to not to suppress his passion for research any further.

Subsequently, he went to the US in 1974. He obtained his Ph. D. degree in the Department of Human Genetics at Columbia University. At the time, genetics was an obscure field.

Going from medical school to graduate school in genetics was a difficult path. In addition to stressful academic demands, Chen was faced with doubts from family and friends, his own sorry for his wife, and financial difficulties. Yet despite the challenges, he never faltered and continued his research.

We are fortunate that Chen has improved lives for many patients and their families by discovering cures for rare diseases. We would also like to thank him for returning to Taiwan, his home country to engage in research on ADR and disease susceptibility genes and promulgate Personalized and Precision Medicine to improve the standing of Taiwan in these fields.

Medical graduate switched to genetic research

“Actually my favorite subject in high school was chemistry. I liked doing hands-on experiments. When seeing different liquids change their colors, I was excited.” Chen reminisced about his days in school and said, “I could have been admitted into the chemistry department for outstanding academic performance, but in the end it didn’t work out.” His disappointment was evident when recalling this period in his life.

With guidance from his family, he enrolled in the School of Medicine. Despite the demands of medical school, he still sought opportunities in the lab. He spent all his summer vacations in his professor’s research lab. “In my 6th year in the National Taiwan University’s College of Medicine, the world’s first human gene sequence was reported. I was really intrigued and wanted to get right into that field,” Chen said.

“I was more of an introvert, and preferred to be left alone since I was little,” Chen added. As Chen analyzes his own personality, he is pretty clear about his own interests and disposition. “Being a doctor involves lots of interacting with patients. I didn’t think that was for me.”

After graduating from the College of Medicine, he went against his family’s wishes, went to study genetics in the US, and started his path as a researcher. Chen was the odd one out among his peers in the NTU’s College of Medicine. He was the only one in his class to switch to biomedical research.

“My parents originally thought that once I entered the College of Medicine, I would forget all about my dream to be a researcher. Little did they know that after 7 years I would still choose this career.” There There is peace and calm in Chen’s voice but the passion in his words is evident.

“Back then my mother was really worried! In her view, being a doctor meant more stability. Academic research is a high-risk profession, and that’s true,” Chen said with a smile. Take Pompe disease, for instance. He could spend dozens of years searching for a cure unsuccessfully. The risk of searching for new drugs to combat rare diseases is substantial.

Since the world’s first human gene sequence was determined, many researchers have entered the field of genetics. Most of them have studied microorganisms such as bacteria and viruses. However, Chen once again dared to be different.

“I think when it comes to researching human genes, particularly genes in relation to diseases; I prefer to look at the big picture. I hoped my entire life was not spent on figuring out the protein structure or function of one single gene,” said Chen.

In the US at the time, many universities had genetics research programs relating to microbiology, but that did not appeal to Chen. He wanted to research human genetics, which was offered by only 3 or 4 universities in the US. He applied to all of them. Columbia University was the first to reply and thus became the destination for his studies.

Despite being overseas, Chen was unfaltering in his career

As he had been in the lab since his undergraduate studies, switching from medicine to genetics was not a challenge at all. It took him only four years to obtain his Ph. D. degree.

Chen jokes, “Maybe it’s because I was so poor at the time that I wanted to get my degree sooner rather than later.” Behind this joke were genuinely tough times. Growing up in an affluent family, Chen was not concerned about money until right before he left the country. Giving up being a doctor meant that from the day he decided to study in the US, he may face issues with money.

Chen’s wife accompanied him to study in the US. They did not have much money and used to pick up unwanted furniture form the streets of New York City. Despite Chen’s scholarship for his graduate studies, his wife had to get a job to cover everyday expenses.

“When my wife married me, many people thought she would live a comfortable life as a doctor’s wife. This doctor’s wife did not live a comfortable life and had to scrape by in New York City.” Listening to Chen, one could hear the appreciation in his words. “I am really grateful for her support and understanding of my dream.”

Chen’s wife was his only support during his postgraduate studies. A friend visiting him in New York asked, “How come no one is helping you?” Despite such circumstances, Chen still completed his studies. He embodied a statement in the Analects where Confucius described one of his students, Yan Hui, as a wise virtuous man for living a simple, happy life despite limited financial means.

In 1978, Chen obtained his Ph. D. degree. He then completed a pediatric residency at Duke University Medical Center and a medical genetics fellowship at the US National Institutes of Health. “As genetic diseases mostly occur in children, it was very important that I return to the hospital to train in Pediatrics so that I can have direct contact with children and conduct research accordingly.”

Finishing residency and fellowship marked the completion of Chen’s academic training, which took a total of 28 years. When he took on his first job as an assistant professor in the Department of

Pediatrics at Duke, he was 35 years old. Many of his peers from NTU’s College of Medicine would have been rich and famous by then.

He was once invited by a magazine in Taiwan to participate in a forum. On arriving at the venue, he discovered that the topic was “Earning my first million dollars at age 30”. He told the emcee, “You’ve got the wrong speaker. I started my first real job at age 35.”

Turning research findings into clinical practice

At Duke University Medical Center, Chen had his own laboratory where he could completely immerse himself in his research on rare diseases. About 7 years, he felt that his laboratory findings needed to be translated into clinical applications to actually help patients.

However, venturing out of the laboratory is no easy feat. “Most of the academic world thinks that the work of drug development lies with the pharmaceutical industry, not the research labs. But big pharmaceutical companies favour to develop drugs for diseases that affect many patients, like hypertension or diabetes.” Chen pointed out that basic research can easily get funded, but not research on drug development. In addition, developing a drug requires large investments of capital.

“Writing grant proposals every five years and then waiting for retirement was not the life I wanted.” He insisted on researching the diagnosis and treatment methods for rare genetic and metabolic disorders. Unlike his peers, Chen was always going against the tide. Because of his efforts, he brought hope to patients with rare diseases and their families.

Chen has successfully developed treatments for two types of genetic metabolic disorders, and such treatments have become the standard therapy. The first is the administration of uncooked cornstarch for low blood glucose caused by the glycogen storage diseases; the second is the drug Myozyme, which is an enzyme replacement therapy for Pompe disease.

Cornstarch works wonders for patients with low blood glucose-associated glycogen storage diseases

Glycogen storage disease is a type of inherited metabolic disorder where patients experience hypoglycemia, which can cause seizures and even death. Chen discovered a treatment. “This is a very simple solution,” said Chen. Patients ingest raw cornstarch in a quantity prescribed by the physician. Cornstarch consists of carbohydrates which are slowly broken down into glucose in the intestines then transformed into blood sugar, thus increasing blood glucose. Such a simple and inexpensive method has improved lives for these patients.

Addressing the deficiency in Pompe disease

Chen’s successful development of enzyme replacement therapy for Pompe disease was a huge breakthrough for patients with the disorder. This discovery brought Chen international fame.

Pompe disease results from an enzyme deficiency that causes severe muscle weakness and cardiorespiratory failure. Most untreated infant patients die before age 2.

On April 28, 2006, the enzyme replacement therapy for Pompe disease discovered by Chen, Myozyme, obtained approval from the US Food and Drug Administration (FDA) and European Medicines Agency (EMA). This is a day worth noting in the history of medicine, and was the culmination of 15 years of the research for Chen.

The new drug meant that the thousands of infants diagnosed with Pompe disease annually were able to surpass the average life expectancy of 6 months. Chen had thus become Taiwan’s first scientist who researched and developed a new drug in the laboratory and saw it through to market launch.

At age 35, Chen became an assistant professor at Duke University Medical Center and also practiced as a physician in Genetics. During his clinical time, he noted that almost all infants diagnosed with Pompe disease would experience an early death. “Breaking this awful news to parents – your child has only months to live – was really unbearable. So I decided to find the cure,” said Chen.

At the time, not many people were involved in research on this rare genetic disease. Not surprisingly, Chen picked the challenging and rarely travelled path and started his 15-year search for the cure.

Teaching students and seeing patients by day, he spent his remaining hours in the laboratory. After countless hours in the laboratory, he knew that the cause for Pompe disease was a deficiency in a glycogen-breakdown enzyme. This resulted in excess glycogen in muscles and the heart, which led to weakness and heart failure.

The incidence of Pompe disease is approximately 1 in 20,000. There are two types: Infantile-Onset and Late-Onset. With the former, symptoms manifest around 6 months of age, and patients often die before the age of one due to cardiorespiratory failure. With the latter, symptoms can manifest between the age of 2 and 60, and patients develop weakness and eventually die from respiratory failure.

Chen’s research focused on developing and administering the deficient enzyme. One major challenge was that as soon as the glycogen-breakdown enzyme entered the human body, it was intercepted and absorbed by the liver and never reached the heart and muscles.

How did Chen ensure that the enzyme reached the heart and muscles? The answer Chen came up with is that the developed enzyme had to carry a code that heart and muscles could recognize.

In 1991, He started to lead a team on a search for the right coded enzyme for Pompe disease. After repeated testing over 5 years, he developed in Chinese hamster ovary cells the necessary coded enzyme. The enzyme proved to be effective in birds during animal studies. Unfortunately this treatment did not receive funding from the major pharmaceutical companies. Clinical trials on human patients could not proceed until the story took an unexpected turn in 1995. Dr. Andrew T. Huang, Chen’s colleague at Duke, and also the founder and current CEO of Koo Foundation Sun Yat-Sen Cancer Center, introduced Chen to the CSRC Group president, Leslie Koo Cheng-Yun. He funded his research via his pharmaceutical company, Synpac. Later on, Koo also funded the first clinical trial on human patients.

Moving the research forward was exciting and at the same time marked the start of a painful journey.

The subjects of the first clinical trial were three infants, numbered 101, 102, and 103, respectively. As the trial unfolded, all three infants survived through the first three years. Yet after 6 months, there was the occurrence of an antibody rejecting Myozyme in infants 101 and 102 who then passed away one after the other. The reason was that the two infants could not produce enzyme in their bodies, hence their immune systems mounted an antibody response against the Myozyme. Further, the delayed treatment also meant that the infants had missed out on an early intervention.

Fortunately, infant 103 did not produce the antibody and survived. Chen proved that as long as infants with Pompe disease start the treatment within the three-month golden period and take two shots of the Myozyme injection every month, they have a good chance to live a normal life.

No time for frustration; patients desperately await a cure

This research took over 10 years which was fraught with much frustration. “What kept me going was the expectation and encouragement from patients and their families”, Chen said. Whenever his students were stuck in a certain experiment and felt frustrated, Chen would take them to see those little patients. “When your experiments don’t render any results, you might face delayed graduation, but for these kids with only a few months to live, they have to face death.” With these words, Chen encouraged his students not to give up despite minor setbacks. “I want them to realize what they are doing is very important, very meaningful.”

The success of clinical trials also caused a few hiccups. Owing to limited budgets and medication quantity, Chen’s team could only choose three subjects for his first trial, which then caused parents of unchosen sick children to protest. Even the White House and Congress in the US expressed their concern. The mainstream American media even questioned the trials. Chen eventually wrote to the New York Times and other media to clarify with a statement.

When the dust settled, the major pharmaceutical giants that previously turned down Chen started to show interest in investment in the wake of his successful clinical trials and proactively invited Chen to work with them.

“I turned them down, because I am a researcher; I am a physician-scientist,” said Chen. Succinctly but fully, Chen expressed his adherence to his ideals.

The treatment for Pompe disease was later licensed to the CSRC Group in Taiwan, which sub-licensed the treatment patent to the US Genzyme Corp in 2000, which subsequently started manufacturing the drugs in Massachusetts, US, and in Belgium. The first patient receiving this treatment in 1999 is now a 20-year-old university student.

This story about developing new drugs and the story of a father searching for a life-saving drug

for his two children with Pompe disease got the attention of Geeta Anand, reporter for the Wall Street Journal, who wrote the book, The Cure, based on her interviews with Chen and others over the course of 18 months. This book was later adapted into a Hollywood movie, “Extraordinary Measures.”

Harrison Ford portrayed the role of a scientist in the movie. “The new drug development process in the movie was pretty close to reality. Scientists in movies are normally very boring. But for the sake of dramatic tension, the character personality in the movie is quite different from myself,” said Chen.

Invited to return to Taiwan to push forward Taiwan biomedical sciences

After successfully developing the new drug for Pompe disease, Chen returned to Taiwan and took up the position as a Distinguished Research Fellow and Director for the Institute of Biomedical Sciences, Academia Sinica, upon the invitation of of Yuan-Tseh Lee, President for Academia Sinica.

In 2000 when the human genome project was completed, the entire humankind’s 20,000 gene sequences were known which re-set the starting line for all genetic research around the world. When genome sequencing was openly accessible, the race was on regarding who would be the first to identify the function of each specific gene and the connection between each gene and illness. Lee as Academia Sinica’s President thought this was a great opportunity for Taiwan’s genetic research and Taiwan could thereby be positioned at the same starting line as all other countries.

Actually before receiving Lee’s invitation, Chen had already started his genomics research at the Duke University Medical Center. Duke University is a private institution after all and could not raise enough funds in a short time to finance such a big project, while the Academia Sinica is able to fund genomics research as a national priority project. Under such circumstances, Chen returned to Taiwan to gauge the situation. “At the time, I was not too optimistic. Sufficient funding is important,

but Taiwan had other problems back then, eg. restrictions in regulations, systems, talents, which can all cause research not to unfold."

At the time, Chen was uncertain about returning. But Lee's words hit the nail on the spot: "If Taiwan were perfect, we would not need you." Because Taiwan was imperfect, Lee came back to Taiwan. Likewise, Chen felt he should return too.

He decided to return to Taiwan. Many of his Duke University colleagues thought he could barely survive a year before he went back to the US. But they were proven wrong. He was back to stay and has completed many important projects.

Joining Academia Sinica to create a genome research powerhouse

During his tenure as the Director for Academia Sinica's Institute of Biomedical Sciences (IBMS) from 2001 to 2010, Chen re-positioned the IBMS' research direction towards Genome and Translational Medicine. He actively promoted domestic and international collaboration, brought together a strategic alliance between Academia Sinica and the international pharmaceutical giant, GlaxoSmithKline, and the US gene-chip company, Affymetrix, in order to conduct large-scale multinational, multicenter studies.

Extending his interest for rare diseases, Chen has established a rare disease research network and care mechanism for patients in Taiwan which has also become an international benchmark attracting many countries to come for a study visit. As a result when international pharmaceutical and biotech companies develop new drugs for rare diseases, they would vie to conduct clinical trials in Taiwan.

Chen has also led his research team into pharmacogenomic research and successfully identify a number of susceptibility genes that predispose patients to adverse drug reactions and makes it possible to prevent certain drug toxicity with a simple gene test.

For instance, regarding the dosage of the widely prescribed anticoagulant, Warfarin, Chen's team discovered that the VKORC 1 gene polymorphism plays a critical role and the team further took part in the International Warfarin Consortium to formulate a universal algorithm based on genetic and clinical data to better predict an optimal Warfarin dosage for each individual so as to avoid abnormal bleeding after taking the medication. This is a model example of Personalized Medicine.

Further, the team has also identified a number of susceptibility genes to adverse drug reactions (ADR). The team's detailed research focused on the pharmacogenetic study of two severely adverse drug reactions -- Stevens-Johnson syndrome (SJS) and toxic epidermal necrolysis (TEN) – that can cause a fatality rate of up to 40%. They identified the genetic marker for Carbamazepine, a drug used to treat epilepsy, and Allopurinol, a drug for gout, both of which can induce severe adverse drug reactions, such as SJS and TEN.

These pharmacogenetic research findings have prompted the world-wide FDA and the major medical associations to re-label these commonly prescribed drugs, Warfarin, Carbamazepine and Allopurinol, with genetic information, and advised doctors to conduct genetic screening before prescribing the medication so as to prevent any adverse drug reactions in patients.

That is to say, when doctors prescribe medication, genetic screenings can be conducted to provide references for the choice and dosage of medication. With these research findings, Taiwan has become the first country to implement overall genetic screenings for drug toxicity. The patent for the ADR risk assessment has been licensed to

PhamiGene, a Taiwanese biotechnology company which has come up with fast screening kits used clinically for ADR prevention.

Chen has also built infrastructures in Taiwan for large-scale genetics and genomics research studies and for high-quality clinical investigations. He founded the Academic Contract Research Organization (Academic CRO) mechanism to facilitate home talents for clinical research and established the Good Clinical Practice (GCP) guidelines to assist Taiwan's investigators conducting translational research.

In addition, Chen has also established the National Genotyping Center (NGC) to provide high-quality and high-throughput genotyping services. Taiwan has since joined many of the international genomic medicine and biobank research consortia. With Chen's efforts, Taiwan has become one of the world's powerhouses for genomic medicine research.

Retired yet still engaged in promoting Taiwan Precision Medicine Initiative

Chen retired last year (2018) and spends half of the year in Taiwan and the other half in the US. He is now able to enjoy fishing and gazing out at the sea. "I really enjoy looking out to the expansive ocean. I could feel my entire self opening up." Chen has enjoyed fishing since he was little. Since he retired, he has had more time to engage in his hobbies. For instance, lately, he is constantly going to Alaska for king salmon fishing.

He is also into books and movies. "Because all my life was spent doing scientific research, I like to read sci-fi fiction and watch sci-fi movies." Sea gazing, fishing, reading, and watching movies, Chen is, as described by himself, indeed a quiet introvert, yet with massive resilience and persistence. It goes without saying that such personality traits are really suitable for academic research which might appear to be incredibly boring to outsiders.

Chen's retirement may seem idyllic. Actually he is living a retired-yet-engaged life, still continuously devoting to the promulgation of Taiwan's Precision Medicine development.

"I officially retired last year and have now retreated from the front line. My lab projects are all finished and students have all graduated. Recently I spent most of my time giving talks on topics of popular science and handing out research advice to young scholars," said Chen.

Further, Chen is still assisting Taiwan to develop its Precision Medicine Program. This Initiative is led by Kwok Pui-Yan, Director of the Institute of Biomedical Sciences, Academia Sinica, which plans to collect data of 1 million people in Taiwan for common diseases ensuing big data analysis necessary to Precision Medicine development. This Initiative is to explore the impact of genetics and living environments and life styles on health and their connection to individual diseases.

This Initiative works in tandem with all medical centers in Taiwan with Chen playing the role of a connector. So far hundred thousands of people's data have been collected. At this rate, the goal of collecting data of up to 1 million people can be reached in three years.

This bank with data from one million people will have a long-term impact. Up to now, humans have not fully accessed the causes of many common diseases, as most of them involve factors like genes, environments, and everyday habits. With the data bank, we can further analyze the connection between all factors and the diseases, and present customized treatments for each individual. This is what the future of precision medicine about.

In addition, the analysis and research of the big data in the data bank can further propel medical care from Precision Medicine to Preventive Medicine. That is to say, we can analyze and predict if someone will contract heart diseases and at what age and with what probability. All of the above can be calculated.

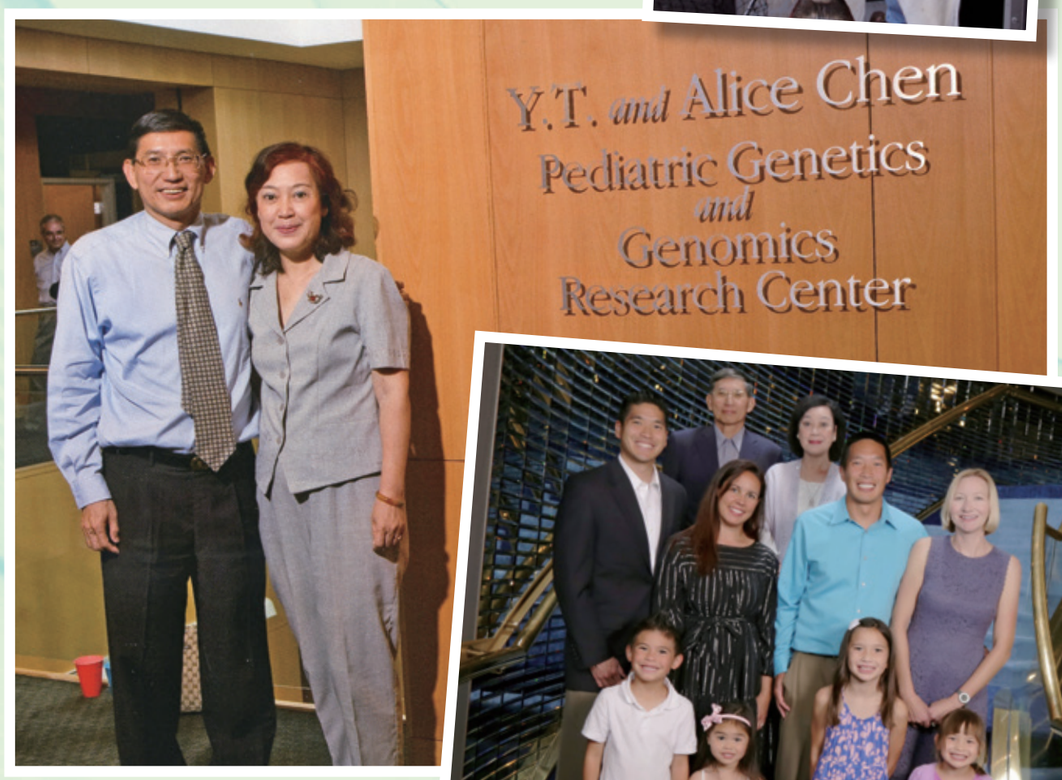
Since future diseases can be predicted, doctors can therefore advise their patients to prevent these diseases by improving environments, dietary habits and daily routines to lower the contraction rate and incidence rate. Much like what the ancient renowned doctor said, "The supreme doctor treats the illness that is yet to occur. The good doctor treats the illness that is just breaking out. The mediocre doctor treats the illness that is already rampant. This is what is meant by Preventative Medicine.

Taiwan's Health Care is advantageous for Medical AI development

Looking to the future, Chen offers his suggestion for Taiwan's biomedical industry and says, "The whole world is talking about Artificial Intelligence (AI). I think Taiwan's advantage in AI development lies with AI for health care, because we have a very good health care system and have over the years collected a large amount of comprehensive electronic data of medical information which are the prerequisite for conducting big data analysis for a better medical care as well as for subsequent AI-based health care." To sum up, Taiwan can rely on its national health care system to advance ahead of many other countries in AI health care.

Over three decades, Chen as a physician-scientist has achieved outstanding performance in medical innovations and academic research. These outstanding results have saved many lives of patients with rare diseases and allowed them to dream about the future. His contribution to Taiwan's biomedical sciences has not only turned Taiwan into a global genomic medicine research center, but has also helped Taiwan moving forward into the Precision and Preventive Medicine era.

Standing on the shoulders of this giant, hopefully our succeeding scientists in Taiwan will be able to see farther and resolve more disease-related mysteries and better safeguard human health.



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A Track Record of Achievements

Applied Science Category—

Fu-Chan Wei

Revolutionary Autologous and Allo-transplantation Research

The World's Most Influential and Pioneering Reconstructive Surgeon

Professor Fu-Chan Wei, Academician of the Academia Sinica, leads the research and medical team he founded over 4 decades ago. The team is committed to basic and clinical research related to autologous and allogeneic tissue transplantation. His research covers ischemia-reperfusion injury of transplanted tissues, normal and pathological physiology of microcirculation, transplantation donor and recipient site biomechanics, allotransplantation animal models, immunoregulation, nerve recovery, transplant function and aesthetic optimization of grafts.

Professor Wei has achieved outstanding academic accomplishments owing to his pioneering, distinguishing and in-depth studies. He is highly acclaimed in the international surgical community, as was demonstrated in his selection as "one of the top 20 plastic surgery innovators in the 400-year history of plastic surgery" by the American Society of Plastic Surgery (ASPS), which praised Professor Wei's enduring contributions as "to be passed on from generation to generation". In 2007, he was selected in Germany as one of the top 100 hand surgeons in history. In 2014, he was selected by the International Federation of Head and Neck Oncologic Societies (IFHNOS) as one of the hundred key promoters of head and neck cancer treatment advancement. In 2015, he was selected by American Council of Academic Plastic Surgeons (ACAPS) and Southeastern Society of Plastic and Reconstructive Surgeons (SESPRS) as one of the top 10 most influential reconstructive surgeons. Since 2017, the Congress of World Society for Reconstructive Microsurgery (WSRM) has established the Fu-Chan Wei Award, the only WSRM award named after a person. The award is presented every two years to honor individuals with major contributions in global reconstructive microsurgery development.

Professor Wei's academic achievements are concretely evident in his publications, including nearly 500 papers published in international journals, 120 textbook chapters, nearly 15,000 article citations, and 18 textbooks. Among them, the first edition *Flaps and Reconstructive surgery*, published in 2009 and translated into four languages— English, Spanish, Portuguese, and Simplified Chinese— is currently the best-selling book in its field. The second edition, published in 2016, received the first prize of the British Medical Association's Medical Book Award-Surgery Category in 2017. He has also served as the chief editor of *International Microsurgery Journal* (IMJ) and the international associate editor of *Plastic and Reconstructive Surgery*. Currently, he is on the editorial committee of more than ten journals.

Professor Wei's outstanding academic contributions have made him the recipient of the highest awards and honors presented by relevant local and international associations. He has also delivered hundreds of invited lectures abroad and served as a visiting professor at more than 80 famous universities. In 2012, Professor Wei was elected as the first Academician in the field of surgery since the founding of the Academia Sinica in 1928.

Through research, Professor Wei has developed a series of toe-to-hand transplants utilized in reconstructing missing fingers; the vascularized fibula osteocutaneous flap for reconstructing limbs and facial defects; and various other flaps used to reconstruct defects all over the body. These results are widely applied clinically, substantially improving the resectability of head and neck cancer, breast cancer, sarcoma, and other tumors, as well as enhancing the reconstructability of missing limbs. Currently, these microsurgical tissue transplantations have become the mainstream of reconstructive surgery.

Professor Wei and his team, through the reconstructive surgical methods he developed, have saved over 30,000 patients. Similar surgeries performed by other surgeons in Taiwan who have received direct or indirect training from him are estimated to have served at least five times more patients, as well as countless other cases from countries around the world.

Because of Professor Wei's passion for teaching, quality and quantity in publishing, and track record of active participation and appointment to important posts in related international associations and organizations, the hospital where he serves at is world-renowned and honorably recommended by the American Society for Reconstructive Microsurgery (ASRM) as a training center and is considered a must-visit "Mecca" for global specialists in the field. From the late 1980s to the end of 2018, a total of 2,228 specialists and scholars from 85 countries have made the pilgrimage to learn from with him. The majority of these microsurgical students are from the United States, the United Kingdom, Korea, Germany, Japan, and Thailand. Additionally, more than 100 physicians who received training from him are now professors, chiefs, or even authoritative scholars in their home countries or internationally. It is therefore not an overstatement to say he has students from all over the world.

Professor Wei has also set up the world's only international microsurgery fellowship program that provides an International Master of Science in Reconstructive Microsurgery at Chang Gung University. Within three years, 18 foreign physicians have graduated. Because of Professor Wei's zealous pursuit and relentless commitment to discovering new technology, his team members have completed the first four domestic cases of hand allotransplantation in Taiwan, while two of his American students have completed four cases of face allotransplantation at Johns Hopkins University, New York University, and the Mayo Clinic.

In view of the aforementioned academic excellence of Professor Wei, he is known as a world-leader in his field and is highly respected internationally. He is proficient at utilizing resources and applying them clinically, cumulating to new advances in cancer and trauma treatments. He fully embodies the spirit of translational research. His innovative academic theories and techniques are not only widely utilized in Taiwan but also around the world. His work has improved healthcare and saved countless patients, and by reconstructing their function and appearance, maintained the dignity of life, while also reducing the burden placed on family, society and country. He has trained countless local and international students and specialists and has made a profound and long-term impact on the surgical community. His overall performance is outstanding, encompassing all aspects of research, practical application, education, service and diplomacy.

Academia Sinica's First Surgeon-Academician Exerts Global Impact on Medicine

Life-long Commitment to Reconstructive Surgery- Rebuilding Dignity through Microsurgery

Academician Professor Fu-Chan Wei is a prominent surgeon as well as an outstanding scientist. His contributions have benefited countless people. Over the past decades, Professor Wei has focused on reconstructive microsurgery. His discoveries have been widely applied clinically, altering the context and form of surgery over the past half century and substantially improving post-reconstruction function and appearance. He has made great contributions to the reconstruction of post-traumatic and post-ablative defects of the body.

The research and medical team established and led by Professor Wei is committed to basic and clinical research related to autologous and allogeneic tissue transplantation. His research covers ischemia-reperfusion injury of transplanted tissues, normal and pathological physiology of microcirculation, transplantation donor and recipient site biomechanics, allotransplantation animal models, immunoregulation, nerve recovery, transplant function and aesthetic optimization of grafts.

Professor Wei is also a successful educator. Over the past decades, he has trained local surgeons and over 2,200 specialists from 87 countries, many of whom have become leaders in their own countries. Chang Gung Memorial Hospital is therefore reputed as the "Mecca"of the global reconstructive microsurgery community, providing the world a glimpse of Taiwan's accomplishments at the forefront of surgical medicine.

"My father taught by example and helped me foster a love of reading as a child"

Professor Wei's road to medicine seemed inevitable. In the 1970s, most of the best Taiwanese students chose to study medicine, and he was no exception.

"Because my father taught by example, all the children in our family enjoyed studying." Professor Wei looked up to his father, who was unable to advance to further studies due to family reasons. Even though his father was only a junior high school graduate, he was an avid reader. Whenever he had a break from his groceries business, he would always be seen holding a book, which was Professor Wei's most profound memory of his father while growing up.

"On arriving home every evening, my father would keep us children company in the living room filled with desks while we were reading and doing our homework. He did not go out much, had little entertainment, and seldom socialized." In a family of one girl and four boys all looking up to their father as a role model, three graduated from medical school and one from pharmacy school.

Turning setbacks into empowering forces

What appears to be an easy ride in school was in fact not without setbacks. Since he was the eldest grandson in the family, under the insistence of his grandfather and family, Professor Wei was not allowed to go to Kaohsiung as he wished to complete high school like his siblings. Instead, he had to stay in Pingtung to study. That said, during the third year of senior high school, his excellent grades gave him eligibility for guaranteed admission into the Department of Electrical Engineering at National Cheng Kung University. “After my entrance examination-exempted admission was confirmed, I was relieved. Unexpectedly, my grandfather and father asked me to take the entrance examination for medical school instead. Without adequate preparation and with a fever on the day of the exam, I did not do well. I had to wait a year to retake the entrance examination and enter medical school,” Professor Wei said.

For someone in his teens, it was a huge setback. Looking back, he felt that he had taken the matter too seriously. “There were many more frustrations at work later on in life. If you look back, you will see that perhaps the setbacks have already turned into empowering elements and even opportunities,” Professor Wei said, using himself as an example. After he graduated from Kaohsiung Medical University, despite good grades and confidence about his eligibility for admission into Mackay Memorial Hospital’s surgery program, he unexpectedly suffered a defeat. However, he did not let disappointment get in the way of his desire to learn plastic and reconstructive surgery at Mackay Memorial Hospital. After a year of residency at the Kaohsiung Medical University Hospital, his second application to Mackay was successful. Not before long, he encountered another setback. Mackay Memorial Hospital would not allow him to start as a second-year resident physician, so he had to start again as a first-year. “I was too amenable back then, so I accepted it.” As the saying goes, “Every cloud has a silver lining.” Because of his previous residency experience, he was more mature than his peers, more capable of solving problems, and received more opportunities to perform and stand out.

Striving to surpass and excel- standing on the shoulder of giants

At Mackay Memorial Hospital, Professor Ming-Ting Chen was the instructor that introduced Professor Wei to the field of plastic and reconstructive surgery. He was the first doctor from Taiwan to have received a complete plastic surgery residency training in the USA, and currently works at Cathay General Hospital. Professor Tsu-Min Tsai, the first in Taiwan to replant an amputated finger in the 1970s, is also one of Professor Wei's most respected mentors.

While working at Mackay Memorial Hospital, Professor Wei had the privilege of receiving supervision from Dr. Samuel Noordhoff, which blossomed into a lifelong teacher-student bond that has exerted an influence on Professor Wei's career for decades. During the 40 years he spent in Taiwan, Dr. Samuel Noordhoff contributed to the benefit of countless patients with craniofacial deformities, cleft lip and cleft palate. After the founding of Chang Gung Memorial Hospital in 1976, Dr. Samuel Noordhoff was invited to take up the post of the first Superintendent. Professor Wei also joined Chang Gung Memorial Hospital at the request of his instructor.

Professor Wei served as a Professor at the Department of Surgery, Chang Gung Memorial Hospital in 1990; Chief of the Department of Plastic and Reconstructive Surgery in 1994; and Dean of the Chang Gung University School of Medicine in 2003. He has now been the Director of the Center for Vascularized Composite Allotransplantation at Chang Gung Memorial Hospital since 2011. Professor Wei's thriving career over the past three decades began at Chang Gung Memorial Hospital. He and his colleagues endeavored to build Chang Gung Memorial Hospital into a global medical giant of plastic and reconstructive surgery.

Notably, towards the end of the 1990s, while Professor Wei was still serving as the Secretary-General of International Society of Reconstructive Microsurgery and International Society of Microsurgery, he promoted the merge of the two societies into the World Society of Reconstructive Microsurgery, which had its first congress in Taiwan in 2001. The unprecedented success of this congress served as the foundation for the Society's exuberance today. Since Professor Wei was one of the key individuals contributing to the Society's founding, and because of his academic achievements and contribution in training the most reconstructive microsurgery specialists, the Society set up the Fu-Chan Wei Award in 2017 to recognize the most outstanding contributors in the field biennially.

Training abroad- discovering new technology for Taiwan

Professor Wei shared a secret on why he entered the field of reconstructive microsurgery. In 1979, Dr. Samuel Noordhoff was the Chief of Chang Gung Memorial Hospital Department of Plastic Surgery. He sent Professor Wei to the Division of Plastic and Reconstructive Surgery at the University of Toronto to expand his training. As for what was to be learned, Dr. Samuel Noordhoff told him, "You will go there to learn what Taiwan lacks and bring back new knowledge and technology." Bearing his mentor's mission in mind, during the first month at University of Toronto, he was curious about many things and yearned to learn everything.

One day, Professor Wei's advisor Professor William Lindsay asked him, "What field particularly interests you?" Professor Wei, whose English proficiency was still inadequate at the time, uttered the English word "microsurgery." This answer led him to his field of specialization for decades to come, eventually making him an authoritative figure in microsurgery whose influence has spread to the world, benefiting countless patients.

Taiwan's first reconstructive microsurgery team- setting a new global standard

Microsurgery demands high precision, eyesight, physical strength, and skillfulness, all of which are indispensable. A surgery takes at least eight hours or even exceeds 12 hours to complete. In 1981, Professor Wei, who had just returned after completing his studies, immediately set up Taiwan's first reconstructive microsurgery team offering routine services.

Taiwan at the time was undergoing economic take-off, and many factories were being set up. Despite Taiwan's economic miracle, the labor safety environment was incomplete, resulting in frequent incidents of occupational injuries, many of which could be managed by the microsurgical

techniques he had learned. In addition, with labor insurance coverage, doctors were not concerned about medical bills that might have refrained patients from agreeing to the microsurgery. This gave Professor Wei many opportunities to treat these patients, enabling patients to regain the ability to work. Hence, he was able to accumulate significant treatment experience within a short period of time.

With the changing of times, beginning in the 1990s, Taiwan's industrial environment gradually underwent transformation, leading to a reduction in the number of occupational injuries. To adapt to this, reconstructive microsurgery was applied to defect reconstruction following cancer resection. This resulted in the increasing importance of microsurgery in post-ablative reconstructive surgery, ultimately becoming the contemporary mainstream.

Professor Wei's confidence in himself is established on continuous and cautious validation. In 1983, the third year after returning to Taiwan, while attending his first international conference in place of Dr. Noordhoff, Professor Wei felt that his experience was already comparable to his respected predecessors, but did not jump to any conclusions. "Before weighing things out from all aspects, I just cannot be 100% sure I am doing better than others," he said.

Because of this mentality, Professor Wei seized every opportunity to participate in international medical conferences to present clinical and research results. "It was not until the early 1990s, after being on stage with top plastic surgeons and interacting and discussing with them, that I was convinced and more confident about our standards reaching or even surpassing global standards," he said.

Pioneering the world's first reconstructive microsurgery intensive care unit

Due to the rapid increase in the number of reconstructive microsurgery cases, in order to improve the standard of post-operative care, Professor Wei proposed the establishment of a microsurgery intensive care unit in 1984. With the support of Chairman Yung-Ching Wang of Formosa Plastics Group and Superintendent Chau-Hsiung Chang of Chang Gung Memorial Hospital, sickbeds were increased to 24 units in 1988. The intensive care unit turned out to be a very successful and pioneering accomplishment, leading to substantial improvement in reconstructive microsurgery care quality and becoming the perfect site for bedside teaching, data collection and research. So far, more than 30,000 patients have received treatment, and Chang Gung Memorial Hospital's reconstructive microsurgery ICU has become widely known since the 1980s and is still leading the world to this day.

"After connecting the blood vessels and nerves through microsurgery techniques, it is necessary to monitor the presence of unobstructed circulation or the time spent on the surgery will have been in vain. The microsurgical ICU has its essentiality," Professor Wei explained. At present, postoperative vascular occlusion is seen in 6% of microsurgery cases, but if the situation can be detected early and a reanastomosis be made, 80% of the cases will recover.

Elected as an academician,an inspiring feat for Taiwan's surgeons

Professor Wei has won innumerable honors throughout his practice. In particular, as a surgeon elected to be an Academician of Sinica Academia, he describes bluntly, "It is the highest honor of my life." Professor Wei was elected as an Academician in 2012, making him the first clinical surgeon Academician since the founding of the Sinica Academia in 1928.

As the saying goes, "Diligence makes a great man." His selection was an encouragement for many in the same line of work and especially for young doctors. "After the electees were finalized, my surgeon colleagues were ecstatic! They were pleased that surgery was finally recognized as a science and not just a technique."

Professor Wei pointed out directly that in the past, the academia viewed surgeons' practice as technical work. "For them, we were just not good enough. My election overturned this perception, and the importance of clinical doctors finally gained affirmation." He also mentioned the importance of translational medicine. "No matter how much you excel in research, if you can't convert the results into something that benefits mankind, the value of the research will be discounted."

Professor Wei's research involves many innovations that have become mainstream concepts and techniques. The fact that he has received numerous highly respected international awards gained him recognition by many fellow Academicians, who ultimately voted him into the highest academic organization.

"Most of the Academicians have a doctorate degree, but I only have a bachelor's degree. This may be a revelation for young people," said Professor Wei. "As long as you are down-to-earth and are willing to focus on improving your academic abilities, chances are you will be recognized in time." Professor Wei often serves as a reviewer for doctorate oral defenses. His father often teased him, "With only a bachelor's degree, are you sure you are capable of teaching doctorate students?" That said, it is worth mentioning that Professor Wei actually studied at University of Toronto, Canada and Louisville University, U.S.A. in 1979 and 1983, respectively.

Professor Wei served as Monks Visiting Professor at Harvard University

Wide praise for his work and publications

Having received numerous honors, Professor Wei's medical and academic research results have been widely acclaimed by foreign surgical communities worldwide. In 2006, the ASPS selected top 20 plastic surgery innovators in the 400-year history of plastic surgery, and Professor Wei was on the list. He was praised for his contributions that "will be passed down from generation to generation."

Additionally, in 2007, he was elected by Germany as one of the top 100 hand surgeons in history; in 2014, he was selected by the International Federation of Head and Neck Oncologic Societies (IFHNOS) as one of the hundred promoters of head and neck cancer treatment advancement, and he was selected by the American Council of Academic Plastic Surgeons (ACAPS) and Southeastern Society of Plastic and Reconstructive Surgeons (SESPRS) as one of the top 10 most influential reconstructive surgeons.

Even though he was often busy performing surgeries, accommodating patients, engaging in teaching and research, and flying around the world, according to records, he has been invited to international conferences and seminars over a hundred times and has been invited to give special lectures at international seminars and universities nearly 700 times. He has managed to produce numerous high-quality publications. Let us see these staggering figures: nearly 500 papers published in international journals, 116 textbook chapters, 18 textbooks published internationally and nearly 15,000 article citations.

Worth noting is that the first edition of *Flaps and Reconstructive Surgery* published in 2009 came in four versions: English, Spanish, Portuguese, and Simplified Chinese. It is the best-selling book in the field to date. On top of it, the second version published in 2016 received the international first prize of the 2017 British Medical Association's Medical Book Award-Surgery Category. Professor Wei also served as chief editor of *International Microsurgery Journal* and the international associate editor of *Plastic and Reconstructive Surgery*. Currently, he serves on the editorial committee of more than ten journals.

Immediate post-surgery records- more than 10,000 data entries

As a reconstructive microsurgeon, each surgery takes at least eight hours to complete. Just how does Professor Wei manage to accomplish such fruitful academic results? His time management indeed draws curiosity.

When asked this question during the interview, Professor Wei walked to the iron cabinets on one side of the office and opened one of the drawers-full of files properly sorted and arranged. "This is a detailed record of every surgery I performed on patients." The records are precious database, on which Professor Wei produces high-quality papers and publications.

"During lectures I often advise surgeons to develop the habit of keeping records, such as the reason for surgery, problems encountered during the process, the outcome, etc. The more detailed the better, as it will serve as proof for future analysis," said Professor Wei.

Despite the many advantages of compiling and accumulating data, a surgeon is usually exhausted by the time a 10-hour surgery is completed. It takes tremendous willpower to spend half an hour recording data. "A surgery must be recorded right after its completion, or there might be forgotten details or error." Starting in 1981, Professor Wei has been keeping a record by entry. To date, he has accumulated a staggering total of 10,000 entries.

From manual to computer input, Professor Wei insists on keeping a detailed record of each surgery. Despite the help of resident doctors and assistants in the recent years, he has asked all audio and video files to be archived within two days. In short, Professor Wei's time management philosophy can be truthfully expressed as "know the truth and persevere."

Professor Wei's reconstructive surgery practice, a must-visit Mecca for doctors worldwide

Over the years, Professor Wei has been relentlessly and conscientiously seeking improvement. "In the first seven or eight years, I could only say we were 'one of the best' in the field. It was not until a few more years later did I feel that we had progressed to be 'the best.' After a lot more hard work, I was finally able to ascertain ourselves as 'unique.'" Professor Wei's definition of 'unique' is conducting pioneering research with global impact, which he and his team have accomplished.

Professor Wei has an extremely high reputation in the field of reconstructive microsurgery, and is always willing to share his discoveries without reservation. Because of this, many people see Chang Gung Memorial Hospital as the “Mecca” in the field of reconstructive microsurgery, where they must visit once in their lifetime to improve their skills. Professor Robert Goldwyn, Chief of the Division of Plastic Surgery at Harvard University once said, “Plastic surgeons who have not been to Chang Gung Memorial Hospital in Taiwan are not considered to have completed their plastic surgery training at all.”

Metaphorizing Professor Wei’s place of work as the “Mecca” is no exaggeration, and the data is self-explanatory. From the late 1980s to the end of 2018, a total of 2,228 specialists and scholars have comes to learn from him. Among them, the majority are from the United States, the United Kingdom, Korea, Germany, Japan, and Thailand. Additionally, more than 100 physicians who received training from him are now professors, directors, or even authoritative scholars in their home countries or internationally.

In order to benefit more people, Professor Wei set up the world’s only International Master’s Program in Reconstructive Microsurgery at Chang Gung University. In three years, 18 foreign physicians have graduated.

Professor Wei has had a profound influence on the world’s reconstructive microsurgery development, making Taiwan’s cutting-edge medical development known to the world.

With professor Wei’s superb medical practice come many compelling stories

Professor Wei’s three most well-known innovative surgical techniques are: using toe transplantation to reconstruct missing fingers; using the vascularized fibular osteocutaneous flap to reconstruct the extremities and upper and lower jaws; and using various flaps for single-stage reconstruction of various defects of the body. These results have been widely applied clinically to become the mainstream of global reconstructive microsurgery, changing the face of today’s trauma and cancer surgical treatment.

Looking back at the many operations performed, it was difficult for Professor Wei to pick the most memorable story. In the end, he chose the story of a boy. More than 20 years ago, a 5-year-old child burned his hands resulting in amputation of all his fingers. Unable to drink water or go to the toilet on his own, the poor little boy relied on his parent’s care. “Later, his parents brought the boy to see me. I found out after a checkup that his remaining hand muscles were still contracting and that reconstruction was possible,” said Professor Wei.

Therefore, Professor Wei removed two toes from the boy’s left foot and three toes from his right foot and reconstructed them into three fingers for the right hand and two for the left. “The results turned out well. he graduated from college a few years ago and now has a good office job.” Professor Wei said as he shared one of the many stories encountered throughout his medical practice.

Professor Wei’s research is original, the outcome of which has greatly benefited patients with head and neck cancer, sarcoma, and other tumors, restoring the function and appearance of their resection sites. “We reconstruct not only their bodies, but also their dignity,” Professor Wei emphasized.

For example, some breast cancer patients worry that their feminine image will be compromised once they have their breasts removed. Therefore, they often struggle with the decision to have lesions removed. However, with today’s new surgical standards, defects can be reconstructed well. “Because the patient has confidence in the doctor and is more willing to undergo resection

surgery, their condition will not exacerbate due to delay. Furthermore, after restoring the appearance through a surgical procedure, the patient will no longer be stared at and will be able to lead a dignified life," Professor Wei said. Other parts like the tongue, the chin, and so on can also be reconstructed. As far as patients are concerned, it is the key to a life turned around.

The sophisticated microsurgery performed by Professor Wei and the compelling stories of patients have been widely covered by television channels and major print media in the United States, the United Kingdom, Hong Kong, and Taiwan. This includes Discovery Channel, National Geographic, and others, which have attracted many international patients from afar to seek treatment.

Conducting allograft transplantation research to accumulate experience

Professor Wei, who stepped into the field of reconstructive microsurgery out of curiosity, has never stopped learning, exploring, and innovating. In recent years, he has focused on allograft transplantation research, with remarkable results.

The full name of allograft transplantation is composite tissue allotransplantation. Unlike general reconstructive transplant surgeries that obtain the patient's body part to repair missing parts, allograft transplantation takes the body part of another person to carry out repair.

In essence, composite tissue allotransplantation techniques are similar to those used in reconnecting a amputee; they involve connecting blood vessels and nerves and other reconstructive microsurgery techniques. The key lies in the need for immunosuppressive drugs after surgery. There is a higher likelihood of allograft rejection compared to rejection after kidney and liver transplants, while the patient's long-term use of anti-rejection drugs to suppress immunity may increase the incidence of diabetes, kidney failure or even tumors, all of which are issues to be thoroughly considered by the doctor.

Chang Gung Memorial Hospital Center for Vascularized Composite Allotransplantation was established in 2001, with Professor Wei serving as the director. "We have studied hand and face transplantation. The face of a black mouse was transplanted to a white mouse in the laboratory, with continued progress." Professor Wei further explained, "We must find the cause of rejection, which stem cell treatments that are less likely to trigger a rejection should be adopted, when the whiskers of a lab rat will move and when a lab rat will start to have reflexive responses, etc." When not busy in the operating room and outpatient clinic, Prof. Wei's research team consists of three basic scientists and several reconstructive surgeons who are interested in research.

After continuously overcoming challenges, Professor Wei and his team members have completed four domestic cases of hand allograft transplantation and two of his U.S. fellows have completed four cases of allograft transplantation of the face at John Hopkins University, New York University, and the Mayo Clinic.

In Taiwan, the first bilateral arm transplantation surgery was completed in 2017. Dr. Cheng-Hung Lin, who was responsible for the surgery, was sent to the United States by Professor Wei and returned to the country after completing his training. The surgery expenses were paid through the Chang Gung Memorial Hospital research fund, and the 13-hour surgery was completed by a team of 20 doctors marking the world's 11th case of bilateral arm transplantation on a patient with amputated limbs. Professor Wei also said the Center was soon to commence allograft transplantation of the face.

"We will continue to move forward with allograft transplantation research, but we shall not rush into things. We will abide by medical ethics and conduct experiments under proper supervision." Professor Wei places great importance in prioritizing patient interest at all times, never trying to gain success at the expense of the patient. "We are very cautious." Other than the one case that was disclosed to the media, by the patient himself Chang Gung Memorial Hospital has never reported the other successful cases of allograft transplantation.

全球顯微重建學生組成 "Fu-Chan Wei Club"

A passion for learning and staying up-to-date

Curiosity is an indispensable element for achieving fame in the research field, and Professor Wei is a good example of this. He actively absorbs new knowledge and enjoys learning new things. "Medicine is especially technology-oriented. I have a great urge to learn and an insatiable thirst for technological knowledge. If I feel outdated, I get weary. I try my best to absorb knowledge against the clock." Professor Wei has been quite interested in the recent integration of 5G and artificial intelligence into medicine. In addition to newspapers, magazines, and books, he has grown to rely on Youtube videos and audio books in recent years to stay informed.

Professor Wei is concerned about contemporary issues and trends, and the future of medicine in Taiwan is certainly at the top of his list. "Taiwan's medical standards are high, but the fields that truly exert an influence on the world remain scarce. It is my advice to the government to focus on some of Taiwan's strongest fields and concentrate and input more resources in order to achieve or to maintain world-leading results. These results will in turn enable Taiwan's medical community to step up to the global stage." This is the wholehearted suggestion of the world-renowned physician.

Changing patient's lives- changing the world

Professor Wei has kept up his busy schedule until he was diagnosed with myocarditis early this year. Another episode of gastric bleeding in August has also temporarily slowed him down a little bit. That said, within less than a month after being discharged for gastric bleeding, he is back to completing multiple surgeries weekly with his team. He said, "Cancer patients can't wait!" Nevertheless, to reassure his family, he has cancelled several lectures and seminars originally scheduled in the United States, Israel, and Japan. In the past, he has had to travel abroad for work eight to nine times a year.

Being a surgeon requires lots of stamina and mental strength. Professor Wei says that he does not have a fitness routine. "My wife often complains about me not taking care of my health, but at least I don't have bad habits. I've been able to sleep six full hours a day in recent years, and I also walk in the Pihu Park near my house, which counts as an improvement already."

Along the way, Professor Wei has accumulated extraordinary academic accomplishments. He has achieved leading status in terms of international reputation in the field, and he is highly respected globally. He has made good use of resources, fully applying his results clinically. This has led to advancements in cancer and trauma treatments, embodying the spirit of translational research. His innovative academic theories and surgical methods have been adopted by medical communities in Taiwan and all over the world.

Professor Wei has trained a great number of domestic and international students, exerting a tremendous influence on the world's reconstructive surgery community. His contributions have successfully saved countless lives, restoring their health and dignity. A comprehensive view of Professor Wei's contributions shows that his considerable achievements do not remain personal but extend to impact others. He has changed the lives of many and he has changed the world.

List of Selected Publication

1. Wei, FC, Noordhoff, M.S. (1986) Fibular osteoseptocutaneous flap - Anatomical study and clinical application. Plast Reconstr Surg 78(2):191-199. (cited 422 times)

2. Wei, FC, Chen HC, Chuang CC, Noordhoff MS. (1988) Reconstruction of the thumb with a trimmed-toe transfer technique. Plast Reconstr Surg 82(3):506-513, 1988. (cited 115 times)

3. Wei FC, Jain V, Celik N, Chen HC, Chuang DCC, Lin CH.(2002) Have we found an ideal soft-tissue flap? An experience with 672 anterolateral thigh flaps. Plast Reconstr Surg 109(7):2219-2226. (cited 1146 times)

4. Wei FC, and Mardini S. (2009, 2016) Flaps and reconstructive surgery. Philadelphia: Saunders/Elsevier.

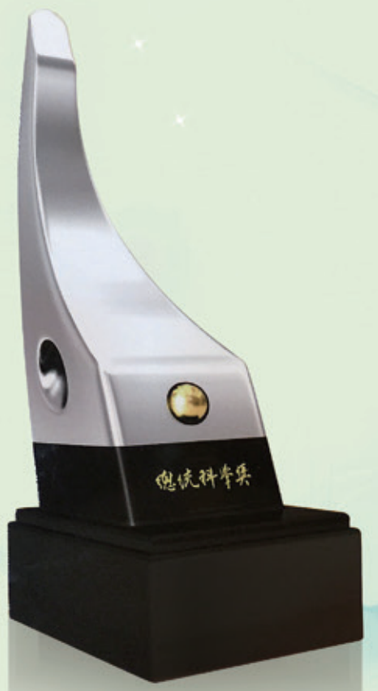
5. Wei FC, and Nidal Farhan AL Deek (2016). Free Tissue Transfer to Head and Neck: Lessons Learned from Unfavorable Results, Clinics in Plastic Surgery, Publisher: Elsevier. USA

EPILOGUE

Chosen from a number of excellent candidates, the three awardees of the 2018-2019 Presidential Science Prize-Dr. Yuan-Pern Lee of the Mathematics and Physical Sciences Category, Dr. Yuan-Tsong Chen of the Life Sciences Category and Dr. Fu-Chan Wei of the Applied Sciences Category are the most outstanding and internationally-recognized scholars who have achieved great contributions in scientific R&D.

Indeed, for decades, they have distinguished themselves in various fields of research with selfless attitude and a sincere spirit of inquiry. Thanks to their dedicated endeavors, Taiwan now can stand side-by-side with advanced countries in various fields of scientific research. Moreover, their research achievements have not only benefited people in this country but also had far-reaching influence on the prosperity of all mankind.

Looking toward the future, scientific development still requires persistent efforts of all scientists around the world. Working hand-in-hand, we will be able to make even greater breakthroughs in science and usher in a new era of international scientific cooperation.



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(2018 ～ 2019)

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